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January 6th, 1916 — Annual Number 50 Cents

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THE IRON TRADE REVIEW

Vol. LVIII Cleveland, January 6, 1916 *No. 1*

Protection for Our Home Market

IN OUR enthusiasm for military preparedness we should not overlook the importance of economic defense. An adequate tariff barrier against European trade aggression is as essential to the security of our national existence as long range coast artillery at Sandy Hook. In this article the problem of protection is discussed with special reference to the iron and steel industry and the influence of the war on international trade. The necessity for handling the tariff from a business standpoint is emphasized.

By H. Cole Estep

"WELL, gentlemen, we appear to agree with Washington on this subject of national preparedness. We don't want war, and we think the surest method of preventing it would be to whittle the Big Stick to a sharper point." The two listeners nodded approval while the speaker, a young westerner suspected of free trade leanings at home, cautiously knocked a lengthy ash from the end of his cigar. This operation was somewhat clumsily executed owing to a sudden application of the air that brought the train up standing.

"Luck's against us," broke in one of the listeners, whose business card bore the legend, "James Douglass, President, Interstate Steel Co., Pittsburgh", "you've burned your fingers and if we lose another 10 minutes, I've lost my last chance to make connections at Harrisburg."

"Quite true," replied the younger man, "also since we agree so thoroughly on national defense we've nothing more to argue about and will be obliged to content ourselves by gazing at a drab landscape decorated with box cars, bottles and—"

"It's not that bad," laughed Douglass, "at least we've had the good fortune to stop in sight of one of the most interesting industrial establishments in the country. I happen to be familiar with it. You see all those new buildings trailing out from behind that battery of coke ovens, back on the hill? Well, that's the benzol and dyestuffs plant of the Middlesburg Anilin Co. It's a brand new enterprise in this country, a real sure enough infant industry; and if it wasn't for the war, the Germans wouldn't let it even get a start."

"Yes, and after the war is over, what'll they do to it?", asked the third traveler. "Our Teutonic friends don't intend to let the American dye business get away from them without a struggle. A friend of mine has just returned from abroad, and he tells me the Germans are not drawing so many men into the army but that there are a few thousand left to keep their big color works in operation. These plants are busy laying up a stock that can be used to good advantage to break the American market and put our young dye makers out of business, once the war is over."

"That's just what we're afraid of," said Douglass. "I've put a little money into that plant and while it's all right now, we don't know what morning we'll wake up and find ourselves face to face with the 42-centimeter howitzers of the German dye industry. We've virtually no tariff protection, in fact duties on many dyestuffs were reduced when the Underwood act went into effect, and we would have no more show if it came to a fight than the 'impregnable' forts of Liege. We're simply taking a long shot in the hope that the government may soon adopt a policy that will permit us to stay in business and do our share in rounding out the industries of the United States."

A Rude Awakening

JAMES DOUGLASS' case is by no means an isolated one. There are thousands of men and concerns scattered all over the country that are in similar positions. When the war broke out at the end of July, 1914, the people of the United States were rudely awakened from their rosy dreams of national self-sufficiency. To use a market phrase, we were caught short and forced to admit that in several important directions our industrial development failed to measure up to the requirements of a modern world power. In the interim since the outbreak of hostilities we have been busy setting our house in order, and now it is high time we began seriously to consider whether the progress that has been made is to form a foundation for

permanent development or to serve as nothing more than a stop-gap during the period of hostilities.

The war forced us back on our own resources and as a result new industries are springing up on every hand. Many of them are intimately connected with the iron and steel business. These industries, as yet, are feeling their way. No one is even reasonably certain as to their future and their growth is correspondingly slow and halting. Yet they represent a development that almost everyone admits is essential to our eventual industrial security. Is there any reason, therefore, why the government should not free them from every possible political handicap and take steps to protect them against the ruthless onslaughts of unscrupulous foreign competitors?

The men who are putting their money and energy into these new enterprises are industrial pioneers, blazing the trail for the caravans of commerce. In the early decades of our national existence we defended the pioneers, who pushed our borders into the western wilderness, with the whole of our military strength. Are we prepared to do as much for our business outposts today? Or do we propose to leave them to the tender mercies of scalping savages?

We Are for America

THERE is no doubt about the sentiment of the country on these questions. The American people are for America. Unfortunately, however, there exists some uncertainty as to the practical ability of the present administration to deal with this problem effectively. Protection is not among the tenants of the party in power. The eyes of the people are turned on Washington looking for deeds, not words, which will bring assurance that our newly fledged industries will be kept from the wolves. And if the deeds are not forthcoming, the people, undoubtedly, will settle the matter themselves before another year is out.

The thoughtful citizen is concerned not alone with protection for the new industries that are springing up as a consequence of war conditions; he also is reminded that many thoroughly established lines of trade, representing the backbone of our commerce, have been tremendously stimulated and that, as a result, prosperity has returned to our midst.

Plain figures afford little conception of the extent of the business revival of the past 12 months, but the readers of *The Iron Trade Review* are familiar enough with the story. Pig iron production has doubled; plants grown thick with weeds have been refurbished and started going; wages have advanced and night shifts pressed into service. Yet the insatiate demand for tonnage remains unstayed and the cry for added production grows ever more insistent. The giant has awakened.

What is true of the iron and steel industry is equally true, to a less extent in some cases, of many other lines. The textile mills are humming; the leather trade is booming and the manufacturers of chemicals, glassware and automobiles are turning away customers. Even the stragglers in the march toward prosperity, like the lumbermen, are getting in step with the times. Given impetus by a vast increase in exports, our business activities have gone far beyond the war order stage and a tremendous internal commerce has been built up. Its quickening effect is felt in the far corners of our country—in the fish canneries of Alaska, the forests of Washington and the copper mines of Arizona, as well as in the industrial centers of Ohio, Pennsylvania and the east.

This prosperity, as well as our new industries, must be defended, perpetuated and protected against outside interference. In our zeal for military defense, let us not forget to shield our enviable commerce. We propose to prepare ourselves, with a strong navy and impregnable coast defenses, against an armed invasion, but unless we fortify our business success against the industrial invader, we shall be as vulnerable as Achilles.

At the close of the present struggle abroad it is not likely that even the victor would care to launch a program of military aggression against the United States, a nation fresh and unwearied by strife. Europe will be sick of war and anxious to rehabilitate her shattered fortunes. The probability of our being subject to attack is made more remote through our greatly enlarged capacity for the manufacture of munitions and our renewed activities along military lines.

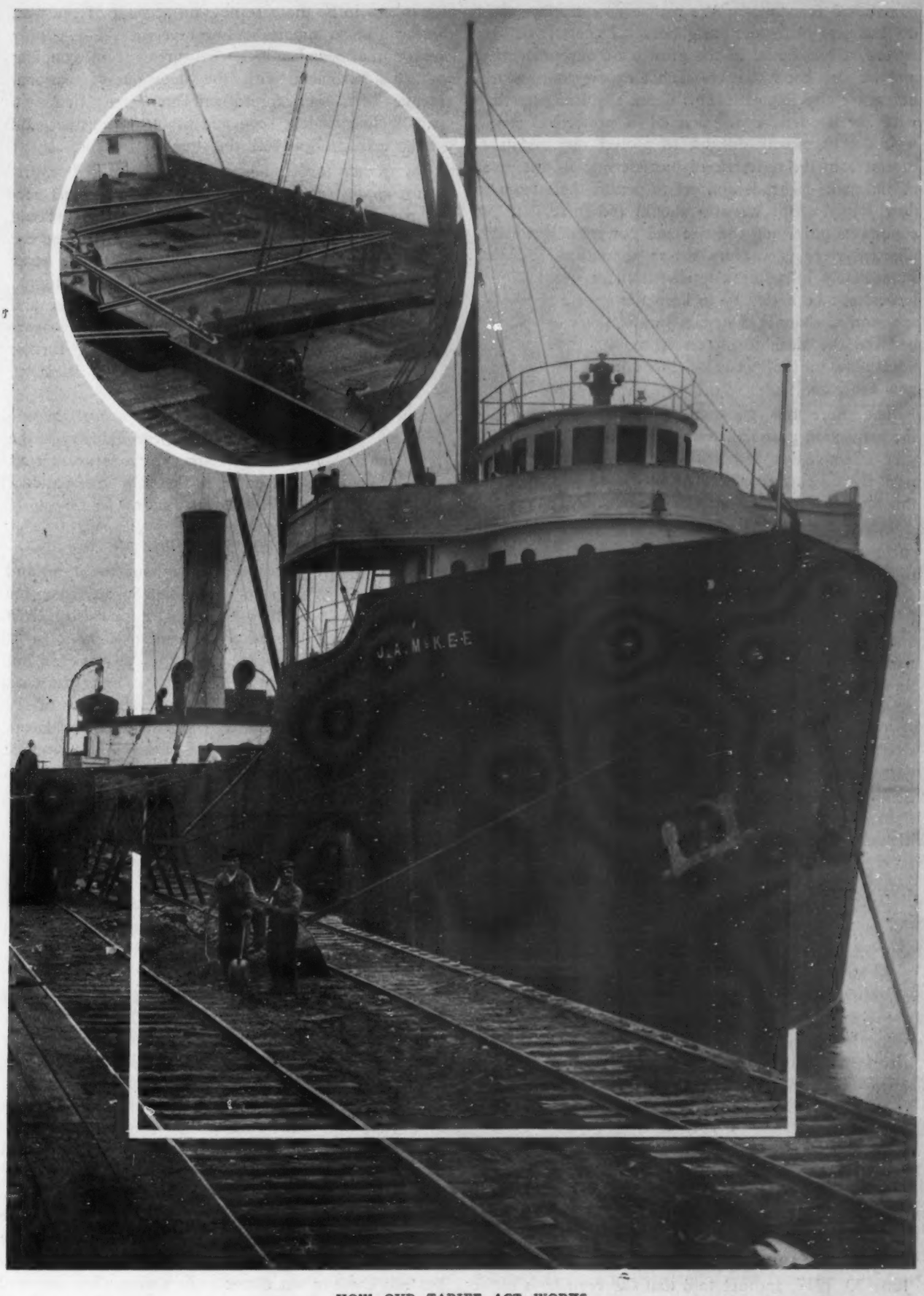
A plan to exploit the markets of the United States, however, would fit perfectly with Europe's ambition to regain her position in the world of trade and manufacture. Our incomparable home market yearly absorbs upwards of thirty-five billion dollars worth of American products. This vast sum, representing twice the value of the annual export trade of the whole world, offers the same irresistable attraction to industrial Europe as a defenseless rabbit to a pack of ravening coyotes.

And to cap the climax, our unintelligent muddle of tariff schedules invites a war of trade and entices the rebuilding of wrecked European fortunes by selling to rich America.

A Question of Freeboard

IN THE fall of the year on the Great Lakes the captains of our 12,000-ton ore carriers keep a close tab on the weather predictions. If storms are probable they curtail their cargoes and gain a little freeboard with which to combat the icy seas of Superior and Huron. So it should be with the tariff. In times of industrial calm we can safely load the ship of commerce as deep as she will wallow; but in seasons when the winds of trade grow fickle and stormy we need more freeboard to ride out the gale. Some factor of safety we always require, but the amount of protection best suited to our commercial requirements is by no means a fixed and unchanging quantity, as some well-meaning congressmen would have us believe.

We have grown away from the Chinese wall idea



HOW OUR TARIFF ACT WORKS

Unloading Foreign Steel Rails at an American Port on the Great Lakes

in national economics. We realize now that we must do business with our neighbors. Exports, we are agreed, are essential to the growth of our prosperity, and we also know that we cannot export continuously unless we also import. This is not at all incompatible with the modern conception of a protective tariff; it is not essentially difficult to protect our manufacturers from the unrestricted meanderings of the river of international trade and yet to permit the stream to flow freely. But we also should recognize that the conditions governing the size and power of this metaphorical river vary from season to season, and that immediately following a terrific thunder storm, higher levees may be necessary to keep the stream within its accustomed channel. Our tariff walls, therefore, should be like the flashboards on a modern power dam, adjustable to the needs of the hour. Such is not now the case.

The more this situation is studied, the stronger the conviction grows that we will never get the necessary effectiveness and flexibility into our tariff laws until there is a radical change in the method of fixing the rates and of dealing with the whole problem.

What this country needs is an untrammeled, non-partisan commission with sufficient authority and ability to give us an intelligent tariff. I expressly avoid the familiar phrase "scientific tariff", because the laws of economics governing modern business are too complex and our knowledge of them too limited to permit the fixing of duties scientifically. But we can at least fix them intelligently, which is more than we have ever done before.

The qualification "non-partisan", used in reference to a tariff commission, also will bear definition. Non-partisan means removed from the influences of practical politics; separated from the log-rolling machinations of office holders. We can't take the tariff out of politics, but we can take the politics out of the tariff. The people at large, through the great political parties, must settle the fundamental question of our tariff policy, as between free trade and protection, and the tariff commission must be so constituted that it will work out the policy the people want.

In short, a non-partisan commission to intelligently execute a definitely protective policy is demanded. There is little doubt that this country is fundamentally protective; even Democrats who go in for a "competitive tariff" are protectionists when it comes to a show down—as in the case of sugar.

The Question of Revenue

UNFORTUNATELY a clear discussion of this tariff question has frequently been befogged by dragging in revenue considerations. We are called to witness how our treasury balance is diminishing at a rate that will transform a credit of $145,000,000 on June 30, 1914, into a deficit of $235,000,000 on June 30, 1917, and are told that the remedy is higher duties. But of course if the duties are too high, then, as happens to be the case now on account of the war, there will be no imports and no revenue. This is only one of the complications that arise from coupling the tariff problem with the question of national revenue. But our forefathers blundered, tied two virtually independent economic problems together and it is up to us to deal with the situation as it is.

Let us not forget, however, that the tariff is primarily an instrument of industrial defense, and secondarily a device for raising revenue. Congress should forget for a while some of its ideas regarding the sanctity of the taxing prerogative, and give us a tariff commission with a free hand to fix duties designed primarily to fit the needs of American commerce and industry. The revenue accruing from such a measure can be more or less accurately gaged, and further necessities, if any, provided for by direct taxation, as we are doing at present.

But by all means we should first strengthen our defenses. The protection of American industry is the paramount consideration; if our country is prosperous there will be no difficulty in keeping the national exchequer properly supplied with funds.

Iron, Steel and the Tariff

LET US now consider what claim the iron and steel industry has to recognition in any plan for tariff defense that might be brought forward. Does the iron and steel trade really need protection, or is it likely to need it after the war? You say yes, but can you prove it? It is advisable to bring forward a few facts to sustain our position. The voice of the muckraker has not been stilled for long, and we do not have to go back very far to reach a period when public sentiment most certainly was not in favor of tariff protection for the iron and steel business. Due to the activities of demagogues in and out of congress, the idea prevailed that steel and iron occupied a 'billion-bulwarked citadel' which entitled it to no consideration from the government or the community. The iron and steel schedules in the Wilson-Underwood tariff act of 1913 stand as one of the fruits of this attitude on the part of the people. The public has changed its mind, however, since Woodrow Wilson was elected President, but we now have among us a group of individuals who point to the present unparalleled activity in the iron and steel trade as evidence of the fact that the industry should be taxed, not protected, forgetting that for the moment we have an infinite tariff barrier.

Now what will happen when the mills and furnaces of Europe once more turn their output into the channels of trade? We can only judge from the record of the 10 months of free trade immediately preceding the outbreak of the war. During this period the whole of both the Atlantic and Pacific seaboards were laid open to the ravages of the foreigner and the stream of imports was growing fast when Mars unexpectedly came to our rescue. At a time when our own plants were shutting down and turning thousands of

men out of work, imports in many lines were actually increasing. These are the facts, unpalatable as they may be to some. Let us examine the actual figures.

Take pig iron, for instance, a crude commodity which would be least likely to be imported. For the fiscal year ended June 30, 1913, 155,169 tons passed through the custom houses of the United States; during the next fiscal year, ending June 30, 1914, with nine months under the Wilson-Underwood tariff, the imports were 136,444 tons. Here is an actual falling off of 18,725 tons. "Not bad", or "I told you so", says the free trader. But wait—the evidence is not all in. In this same period the domestic production of pig iron *decreased* from 31,765,037 tons to 26,707,993 tons. In other words the industry was slowing down, and pig iron production for the 12 months ending June 30, 1914, was only 84 per cent of the output of the preceding fiscal year. Now what about the imports? They also fell off, *but not so fast.* The imports for the fiscal year 1914 were 88 per cent of those of the previous year. There you have it—*a relative increase* in imports of something like 4 per cent. This is not enough to worry about to be sure, but it shows the tendency with pig iron on the free list, and had not the war intervened, the figures would have become sharply accentuated. Imports, too, were choked off during 1914 by the excessively low prices prevailing in the United States; with domestic No. 2 foundry down to $14.75, delivered in Philadelphia, British and Continental producers were satisfied to keep their iron at home. Had our prices been anywhere near their present level, the custom house records would have told another story. But we only need to turn to some of the more highly finished rolled products to obtain more positive evidence.

During the fiscal year ended June 30, 1914, with domestic production dropping steadily, imports of blooms, billets, rails and tin plate actually increased, not in infinitesimal increments but with leaps and bounds, over 300 per cent in the case of rails and nearly 100 per cent in the case of tin plate! Surely these are facts to be reckoned with. Here are the figures:

	Imports	
	Fiscal Year 1913	Fiscal Year 1914
	Gross Tons	
Blooms, billets, etc	20,869	37,604
Steel rails	5,024	15,507
Tin plate	12,654	21,821

We cheerfully concede to our free trade friends that these quantities are not enough to have a far-reaching effect on the home market, but the tendency is very clear and the figures quoted represent, in the case of 1914, simply the first tricklings of the flood that was miraculously diverted by the war. And as was stated previously, the imports were sufficient to throw the entire market on both coasts out of gear.

Let us turn to still more highly finished products, cutlery, tableware and kitchen utensils, lines that absorb a very respectable tonnage of high grade steel. What are the facts? In the fiscal year 1913 we imported cutlery to the value of $2,026,564; in 1914 these imports jumped up to $2,860,519. This increase amounts to over 40 per cent. Don't forget that during this period the duty was reduced and domestic production fell off sharply. The statistics for tableware and kitchen utensils tell the same story, with an increase in imports of about a third, from $667,486 in 1913 to $872,690 in 1914.

These are facts which a tariff commission, if we had one, would study. They show clearly that the iron and steel business of the United States, highly developed as it is, cannot be expected to hold the home market and pay the American standard of wages without some protection against the lower producing costs of Europe. The American steelworker gets from 150 to 300 per cent more for his day's work than his compatriot across the water; the mechanical equipment of modern mills in the United States, Belgium and Germany is practically identical; in America the ore mines are over a thousand miles from the furnaces while in Europe these units are practically adjacent. This, in brief, is why the American steel maker needs

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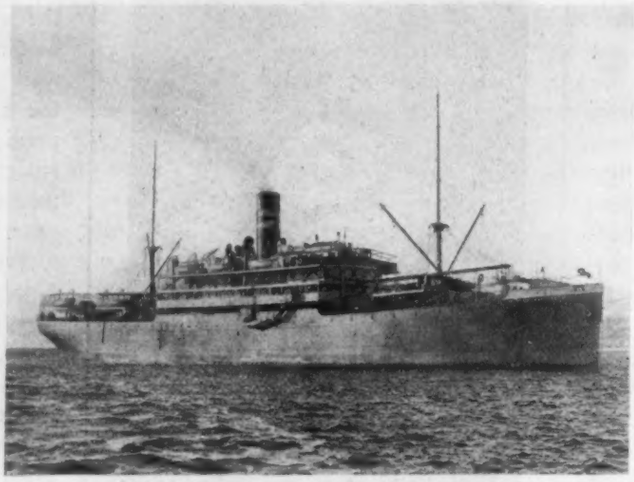
Does He Mean the Tariff?

"Many conditions about which we have repeatedly legislated are being altered from decade to decade, it is evident, under our very eyes, and are likely to change even more rapidly and more radically in the days immediately ahead of us, when peace has returned to the world and the nations of Europe once more take up their tasks of commerce and industry with the energy of those who must bestir themselves to build anew. Just what these changes will be no one can certainly foresee or confidently predict. There are no calculable, because no stable, elements in the problem. The most we can do is to make certain that we have the necessary instrumentalities of information constantly at our service so that we may be sure that we know exactly what we are dealing with when we come to act, if it should be necessary to act at all. We must first certainly know what it is that we are seeking to adapt ourselves to."

protection and why he has a right to demand it. In this and immediately preceding paragraphs we have dealt with the tariff problems of the iron and steel industry in the light of conditions as they existed before the war in Europe. Let us now turn directly to the future.

What can we expect when trench digging, grenade throwing and fighting cease to enjoy their present popularity; when the mills, foundries and machine shops of the Triple Alliance and the Quadruple Entente are shifted from the production of ammunition and guns to the manufacture of the more prosaic articles of commerce? Here we have a condition that is without precedent in the world's history, and we must be prepared to meet it. We have already pointed out how the tremendous buying power of the American people will act as a magnet on the business communities of Europe, once the war is over, and how it is only natural to suppose that strenuous efforts will be made to cash in at the expense of the United States. When the war broke out, imports were rapidly increasing; they jumped from an aggregate of $1,813,008,234 in the fiscal year of 1913 to $1,893,925,657 in 1914 and were steadily mounting month by month. A tariff that permitted such a state of affairs before the war is likely to admit a veritable flood once Europe sets out to recoup. In other words, our foreign friends feel that we are legitimate prey. If we are to retain any proper control of our home market, and if we expect to have anything to say about the liquidation of the tremendous balance of trade now standing to our credit, it is certainly essential that we readjust our tariff schedules so as to prevent the wholesale dumping of European manufactures on our shores as soon as the war is over.



THE MESSENGER OF INTERNATIONAL TRADE

Adequate protection does not imply the erection of a Chinese Wall around our borders; instead it connotes a flourishing but regulated commerce with our neighbors

The question now arises, will Europe actually be in a position to do us any harm? In other words, why worry about rearing a tariff wall against an exhausted continent? When the war is over the great industrial nations of the Old World, it will be argued, will be spent and emaciated by years of ferocious destruction, with scarcely enough vitality left to set about the slow and painful task of rehabilitating their shattered frontiers, and certainly with no energy to spare for a trade war with the richest and most prosperous people on earth. Why should our manufacturers and business men fear encroachment from a land that has reverted to chaos? Europe after the war, we have been led to believe, will be completely down-and-out.

It is advisable, in view of popular conceptions of the cost and destructiveness of war, to examine this phase of the problem in some detail, and actually determine, as far as we can, Europe's ability to compete in the markets of the world after the close of hostilities.

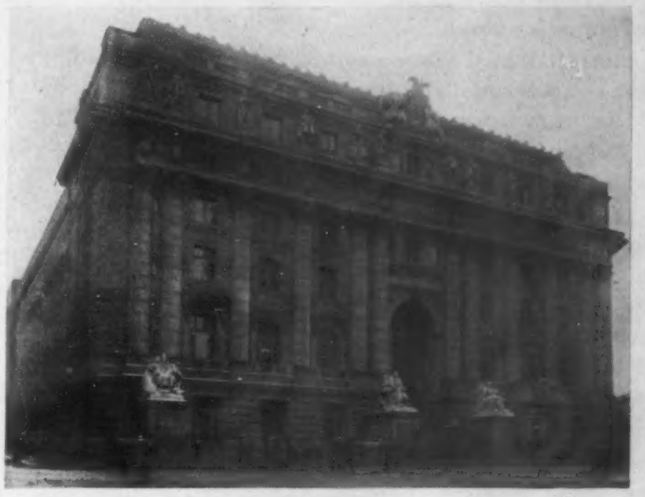
Now the ability of a nation to compete in international trade depends on the *productive power* of its people and have we any evidence that the productive power of the principal nations of Europe will be materially lessened by the war? On the contrary, there is a strong liklihood that it may actually increase, in spite of the loss of men. Compared with the total population, the number of men killed or totally incapacitated in battel is small. Against this loss we must balance the increase in efficiency due to the stimulus of war conditions and the mobilization of industry. We have an example of this in the steady increase of pig iron and ingot production in Germany throughout 1915, indicating ample ability to keep the wheels of commerce moving even with 8,000,000 men under arms. German pig iron production jumped from 586,661 metric tons in August, 1914, to 874,133 tons in January, and then climbed on up to 1,033,078 tons in September. The output of steel showed a similar remarkable growth, from 566,822 tons in August, 1914, to 1,174,350 tons in September, 1915. The American steel manufacturer would do well to take these figures to heart and speculate on what may happen when "the boys get out of the trenches".

We hear a good deal about the terrific destruction of property in the present conflict. But a cold analysis indicates that the actual area of ground fought over and subjected to shell fire is less than 5 per cent of the total area of Europe and the British Isles; even if everything within this zone were destroyed, it would have but little effect, for instance, on the potential production of jack knives for the Yankee market. As a matter of fact, the destruction of plant in the war zone is less important, relatively, than our annual fire loss of $300,000,000. Furthermore, machinery and modern methods of production make possible the accumulation of wealth almost as fast as it *can* be destroyed. Wealth must be constantly renewed in times of peace and the amortizing processes of nature are but slightly accelerated by war. In addition, Europe today has more and better equipment avail-

able for manufacturing purposes than she had when the war started and most of it came from the United States. Witness our enormous exports of machine tools and metal working apparatus of all sorts, including not only machine shop equipment but quantities of molding machines and other foundry devices, forging presses, sheet metal working tools, heat treating furnaces, etc.—the list embraces every conceivable kind of appliance for smelting, casting and working in metals, from ball-peen hammers to blooming mills.

American manufacturers may yet see the day when the tools and equipment they sent to Europe to be cast into Hell's cauldron of destruction will be turned to a new account and utilized for the production of goods with which to capture the American dollar. An iron master from the north of England is reported by Isaac F. Marcosson as saying:

"After the war we can adapt the 'automatics' now making shells to a 'quantity production' that will give England a whole new industrial commerce." This significant remark indicates the kind of ideas that even now are running through the heads of the industrial captains of the Old World.



THE GUARDIAN OF THE HOME MARKET
The Custom House should be the governor of international trade, promoting the easy exchange of national products, yet protecting our industries from unfair competition

To all this, to the augmented equipment and the increased facilities for mass production that flow from the mobilization and nationalization of industry, must be added the spirit of conquest and achievement that animates men and nations tried by the fire of conflict. Every great war brings it to the surface; it is the one virtue that appears to flow from a welter of vice. Germany came through the war of 1870 with a new sense of strength and confidence; large enterprises in new fields were successfully launched and great leaders of industry came to the fore. England emerged from the Napoleonic wars with a great feeling of pride and power and the period that followed was that of her most sure and rapid economic advance. The northern part of the United States after the civil war felt a similar impulse, and it is probably no accident that the ensuing years witnessed unusual triumphs in the fields of industry. A great war acts as a powerful stimulant, lifting the minds of men to large undertakings.

In Europe, at the close of the present struggle, therefore, we should not look for a collapse of industry and finance, but rather should prepare for a commercial battle of huge proportions. We also should make sure that our own incomparable home market is protected and buttressed against the rising tide.

Squaring Up the Balance of Trade

THERE are two features connected with the probable dumping of European manufactures on the American market after the war that merit a little special attention. I refer to the balance of trade and the shipping situation. The former is truly enormous and eventually must be liquidated in some manner. For the year ending June 30, 1915, the trade balance in favor of the United States aggregated a billion dollars, eclipsing all previous records by over $350,000,000. Since the beginning of the new fiscal year, it is safe to say another $500,000,000 has been added to our credit. Incomprehensible as these figures are, they do not fully represent the strength of our position, for the "invisible balance" also is more in our favor than usual, due to the cutting off of tourists' expenditures, etc. In ordinary times trade balances are written-off by the shipment of gold or goods, or by the interchange of credits. The latter may be taken to include the transfer of securities.

Bankers seem to be agreed that the shipment of more gold to this country would be likely to do us more harm than good, and even now the savants of finance are casting about for some more satisfactory method of restoring sadly listed foreign exchange to an even keel. Furthermore, our neighbors across the water have none too much gold to ballast their own credit operations and are by no means anxious to give up any appreciable quantity of their hoardings.

We must look to something else than gold to settle the balance of trade, and our thoughts naturally turn to the great quantities of American securities held abroad, estimated at several billions. How about these? Perhaps they would serve better than a flood of manufactures. At the outset, however, we bump into the fact that Europe considers our engraved paper one of her best assets—a solid anchor to windward with which she is loath to part. The events of the year, including the negotiations preliminary to floating the Allies' loan of $500,000,000, have proved that the stolid Briton, the canny Scotchman and thrifty Francois are going to hang onto their securities just as long as they can. Also a great quantity of these securities are the property of insurance companies that

transact American business; they have been deposited under various state laws as a pledge to policy holders and cannot be withdrawn unless the companies owning them want to pull up stakes and quit.

We are now brought face to face with the cheerful probability that the chancellories of Europe will do all in their power, once the war is over, to encourage the liquidation of their overwhelming debt to this country by the liberal shipment of goods. It is true, as has been pointed out by an eminent American economist, that the individual foreign manufacturer is not likely to be interested in paying up the balance of trade, the chief aim of his activities being to get as high a price for his particular output as possible. But we should not lose sight of the fact that the war has brought about a nationalization—almost a socialization, if you please—of Old World industry, commerce and finance, with the result that the individual manufacturer will probably be called upon to serve the state first and himself next in the period of reconstruction, as well as during the actual duration of hostilities. If national interests appear to demand the temporary dumping of products on the American market, even at no profit to the manufacturer, you will find that every effort will be exerted to put the plan through.

Owing to the stupidity of a succession of American administrations, the carrying trade of the world is practically all in the hands of foreigners. Now these foreign ship owners are not going to make it hard for the European manufacturer to get his goods across the Atlantic. Previous to the war we saw pig iron and steel beams shipped three-quarters of the way around the world from Antwerp to Puget Sound for a third of the overland freight from Pittsburgh; we witnessed the carrying of plates and bars from Hamburg to Philadelphia for less than the rail freight from the Mahoning valley to tidewater, and in the times to come we are going to see these rates put to shame. In the first place the bulk of the freight, foodstuffs, etc., is eastbound and vessel owners are always glad to make attractive rates to secure cargoes for the return voyage to American ports—rates *not* subject to regulation by the interstate commerce commission. Furthermore, with the signing of the treaty of peace, there will be a tremendous tonnage of merchant bottoms dumped on the market, resulting inevitably in a fall in carrying charges. The British admiralty alone will release some 800 steamers of over 1,000 net tons each that are now withdrawn from commercial service. The entire German merchant fleet will again become a factor in the world's trade, encouraging exports from Germany. All this will surely have its effect on the shipment of foreign goods into the United States.

Now we are anxious to help our European customers to conveniently liquidate the balance of trade against them, and we welcome imports of the proper character, but we ought to have our tariff so in hand that these things can be accomplished without upsetting, disorganizing and paralyzing American business. We are willing to co-operate in the re-establishment of international trade, but we do not propose to act contrary to the interests of our own home market.

"Infant Industries"

BEFORE closing, I want to revert to the new industries that are springing up in our midst as a result of the cutting off of supplies formerly obtained from Europe. Through the establishment of these enterprises the United States is becoming a more self-contained nation, and there are few indeed among us who would counsel giving up the ground we have gained. Here clearly is a case where the tariff should be revised upward. We thought that "infant industries" were extinct, but now they are in our midst again, and all the gibes of jokesmiths and paragraphers will not alter the situation.

War conditions have led to the establishment of new plants and equipment for the domestic production of high grade cold rolling machinery, ball bearings, benzol, dyes and colors, creosote, India paper, chemical glassware, optical goods, flaming arc lamp carbons, fine porcelain ware, crucibles of American clay and various other articles. Shall we sit idly by and permit the capital that has gone into these new enterprises to be wiped out after peace is declared? Even theoretical economists and many hide-bound free traders are willing to concede protection for young industries. In the very nature of things a new industry is at a comparative disadvantage and must be helped over the rough places. Men of sound economic sense, not necessarily high protectionists, can readily appreciate the force of the "infant industry" argument. Among such individuals, no one stands higher than Prof. F. W. Taussig, of Harvard University, who expresses himself as follows:

"Notwithstanding early prepossessions to the contrary, I am disposed to admit that there is scope for protection to young industries. Any period of transition and of great industrial change may present the opportunity. The early stage of any new industry remains difficult. In every direction economists have come to recognize the immense force of custom and routine even in the countries where mobility and enterprise are at the highest. Departure from the habitual paths of industry brings unexpected problems and difficulties, false starts and initial losses, often a fruitless imitation of familiar processes before new and better ones are devised. All this is made more trying when the young competitor is striving to enter the market against a producer who is established and well equipped. The obstacles in the way of promising industries, though doubtless not so great as they were a century ago, remain great."

Among our various young industries, the manufacture of benzol is of special importance. Also it is intimately connected with the iron and steel business, being an integral part of the by-product coking process. Benzol is essential to the production of aniline dyes and colors and is therefore of particular significance

at this time. As a result of the increased production of benzol, a number of dye and color works have been established in the United States in the past few months.

This much is certain, however—the German dye makers who have heretofore monopolized this field of enterprise, if they are ever given the chance, will smash our fledgling domestic benzol and dye business into star dust and scatter it in the waste places of the universe. The conversation recorded at the very outset of this article, stating that our Teutonic brethren are even now operating their color work to accumulate a stock with which to clean out the American producer, is based on fact. This will be no ordinary case of dumping, but war to the finish with the control of the American market as the stake. Cost of production will cut no figure in the contest. Our only hope lies in the tariff, and what do we find?

Benzol is "protected" with a magnificent duty of 5 per cent *ad valorem;* alizarin, a valuable dye base, and dyes obtained from alizarin, anthracene and carbazol are on the free list! If our tariff were in the hands of a commission equipped with commercial sense there would be no cause for alarm; but with congress, specially as it is now constituted, our only shield, we tremble.

Wanted—Men of Sense

TO SUM it all up, we need a settled tariff policy, protective in its essence, administered by a large commission chosen from the ablest business men of the country. Since the first bill was approved on July 4, 1789, just 261 tariff acts have been enacted by the American congress. Is it any wonder our present law has become, in many respects, a senseless jumble of contradictions and absurdities? Heretofore tariff schedules have been fixed according to political expediency instead of in the light of business knowledge. Hereafter, let's see to it that the politician goes into the discard.

To secure a satisfactory banking system we established the federal reserve board; to give us uniform freight rates and a fixed railroad policy, we have the interstate commerce commission; likewise, to insure permanency in our international economic relations, as well as safety to our home market and protection for our domestic industries, we should have a tariff commission composed of men of tested business judgment.

Home Markets First in West

HOME markets rank first with western steel mills. The manufacturers are being swept along on a flood of domestic business which has poured in during the past few months. Western mill capacity had not been absorbed in filling foreign war orders, but despite this, the plants have not been successful in coping with the home business. Foreign buyers were slow to contract for their supplies far from the Atlantic shipping points, and before the demand for war supplies reached the west in full volume, home demand began to assert itself. Steel makers were thus enabled to decline outside tonnages, in the knowledge that sufficient business from this country would shortly develop to fill their mill schedules.

Mill books in Chicago and vicinity show a small tonnage of Russian rails, some plates for export to Japan for ship building and also a small tonnage of large rounds for shrapnel-making. However, this represents only a small percentage of the total tonnage recently booked. Regular customers have been able to cover their requirements first, and steel companies have uniformly met the home demand before considering foreign requirements, even though the latter might offer a higher price. Many inquiries for large tonnages of steel bars for munitions have gone begging in Chicago with no manufacturer willing to consider them.

The wisdom of this policy is now clear, although it retarded filling western mill books for some weeks after eastern manufacturers had accumulated a large tonnages. When the home demand started, it came with a rush that quickly brought capacity operations. Any decline in the demand for war materials would provoke little disturbance in the west, owing to the small proportion of such orders taken in that district. The outlook for a continued demand from home consumers is bright, and the efforts to keep up with these orders are finding expression in large plant extensions.

Foreigners Are Persistent

Although practically no capacity is available until July 1, and delivery on much of the tonnage now ordered will be made in the third quarter, foreign demand persists and scarcely a week passes without large tonnages being offered. No premium is sufficient to tempt bookings of this sort, though every effort is made to care for American consumers who need additional supplies of finished products.

Many manufacturers of products other than those going into the making of munitions also have refused to book foreign orders. In some cases, those who thus preferred to run light for a time have been rewarded by a large business from domestic sources. These conditions have been of material aid in protecting the domestic consumer. With mills in the west choosing the character of their business, many home consumers of steel were able to secure deliveries impossible in some other sections. Steel intended for home use is practically the only product of the western mills.

Future Markets for Machine Tools

FAR FROM being misled by present prosperity, machine tool builders of the United States today are devoting serious thought to the consideration of conditions as they will be when the abnormal demand for their product ceases. What will the opportunities be for the development of our foreign markets? Must our manufacturers prepare for a stagnation of trade, or will business justify the operation of new facilities for production?

By F. A. Churchill Jr.

NEITHER Europe's war cloud, darkening all the eastern horizon, nor the smoke belching from a thousand hastily erected chimneys in our own land, suffices to limit the vision of the far-sighted men who guide the destinies of American industry. Notwithstanding the unprecedented impetus which the needs of belligerents have imparted to mine, mill and factory production in the United States, these men today are giving deep and serious consideration to the problems which must confront them at the conclusion of hostilities abroad. Realizing only too well that this country, apparently so beneficially affected thus far by war demands, must bear its share of the burdens imposed by war, and convinced through experience and study that the world is to face a new economic development in the years to come, they refuse to let present prosperity blind them to the responsibilities of the future.

Soldiers, students and captains of industry beyond the Atlantic assure us that peace will bring in a new era. The social fabric of a half dozen great nations is to be reorganized, it seems. The responsibilities of colossal debts, the economies now being inculcated by pressing need, the co-operation and co-ordination which may be made possible by the union of millions in the autocratic democracy of a stringent military discipline, is to develop a trade competition, the like of which has never been known. In this unparalleled contest, we are informed, the efficiency methods of the general staff will be applied to constructive effort, as they are at present directed toward destructive operations. The estwhile belligerents, lean and muscled by adversity, will set a pace in production which peaceful countries will find it difficult to emulate. All this we are told, and more.

Whatever the motive behind these warnings may be, it is evident that they have not fallen upon deaf ears. Nowhere in American business affairs is the problem of preparedness for the commercial future more seriously considered than in the iron and steel industry, which in magnitude of exports and growth through war conditions is only exceeded by the trade in breadstuffs. During the nine months ending with September, 1914, this country shipped $152,800,000 of iron and steel products abroad. Through a similar period, ending with September, 1915, it sent overseas $251,800,000 worth of products, a gain of more than 64 per cent. Orders for delivery many months ahead have since that time increased the percentage of exports to a marked degree. In order to perform this feat, mill and factory capacities throughout the nation have been enormously increased. The resultant problem which peace will bring is twofold. How may our manufacturers utilize their enlarged capabilities? How best may they meet the furious competition promised, in the home market and abroad?

A Representative Vantage Point

In order to answer these questions satisfactorily, we may well study them from the viewpoint of a representative and important phase of the iron and steel industry, one which has been vitally affected by the war's demands. Since the beginning of hostilities, the machine tool manufacturers of this country have experienced a constant and phenomenal growth of business, a growth so remarkable that even the layman is familiar with it through his daily papers. To satisfy the demand, millions of square feet of factory space have been created, quantities of special machinery have been acquired or built, new processes have been devised and taught to employes, the labor situation has taken on a new complexion, and in many cases, the whole character of an organization has changed. It is argued that the huge profits received have far more than paid for the additional means provided to win them, but this in no way alters the fact that the increase of resources, consisting not only of actual floor space and tools, but also of capital concretely invested in new methods and in the time consumed in training workers to their tasks, will remain at hand and unless adequately employed, will constitute a definite overhead charge on our industrial establishments.

Some Problems to be Met

The restoration of the wage equilibrium alone involves a problem of redoubtable proportions. Will "pay check psychology", as exemplified by the separate bonus envelope, leave with its cessation an amicable relation between employer and employed? Or will matters be further complicated by the unwillingness of labor to return to normal conditions? Again, what will be the effect of the liberation for peaceful uses of the great quantities of machinery exported during the war? Will a lackadaisical government policy permit the dumping on our shores, not only of machines in excess of European requirements, but also of new products created by the use of such equipment as may be retained by the present belligerents for the world trade campaign they predict? To what extent will increased buying power in this country augment the purchase of machine tools, deferred for a long time before and during the war on account of financial stringency? How serious will be the depreciation of the countless tools now operated day and night, in many cases by amateur mechanics and women, in European centers? What percentage of new demand, resultant from this depreciation, may our builders hope to supply? Or, to adopt a new surmise, will the European demand be contingent at all on the outcome of the war, or will it prove immutable, a product of geographical conditions only? These are but a few of the questions occupying the foremost minds of industrial America.

To the credit of our machine tool industry, let it be said with authority that a spirit of sane, healthy optimism pervades it today. Leading manufacturers, while they deplore certain ill results bound to be occasioned by the present activities of ephemeral concerns which have entered the field for the immediate gains to be made, state definitely their belief that no calamity need be dreaded. They look confidently to the home market for a decent portion of the post-bellum

demand; but they are resolute in affirming the need of developing our world market. This, it appears, will be centered chiefly in Europe. South American and oriental possibilities, for a long time to come, will be comparatively small. In the commercial as well as in the military contest, it is averred, the best defensive tactics consist in taking the offensive, in meeting the enemy upon his own ground. As against the forces of intense economy and national co-operation which Europe may bring to bear, we can marshal our genius for quantity production, our pre-eminence in the manufacture of automatic devices and labor-saving equipment, and our increased facilities, resulting from the present exigencies.

The general opinion among representative machine tool builders as to the effect of the present strenuous usage upon European machines, does not appear to hold with that of the theorist who recently declared that most of these tools will be fit only for the cupola when they are done with munition-making. Admitting that a considerable proportion of these machines will be capable of several years' service in the peaceful arts: it is pointed out, on the other hand, that no small amount of valuable machinery has already been destroyed by the actual hand of war, particularly in northern France and Belgium, and that before the strife is over, other important manufacturing centers may be similarly ravaged. The replacement of lost machinery offers an immediate field for American enterprise, in competition with that of renascent Europe. What the extent of the field will be, is for individual conjecture.

Future Scarcity of Machinists

We have heard a great deal about the possibilities of cheap production across the Atlantic, a production spurred on by the goad of debt and the ambition to recover lost markets and prestige. Against this must be checked off the probability that the ranks of expert machine tool operators will be seriously depleted, not only by death and wounds in battle, for a great proportion of these workers today are behind the lines supplying munitions, but by the inevitable re-distribution of labor into depopulated fields, such as that of agriculture, for instance. It is the peasant-soldier whose ranks have been the most seriously thinned. Machinists will be tempted away from their vocation by more attractive opportunities in lines which, needing workers more seriously, will offer better prospects. In spite of national poverty, there will be a tendency to higher wages in specialized lines. Here again, American supremacy in machine tool development will have its innings. Against European industry, which generally speaking, requires an individual skilled operator to each machine, we may summon up our automatic methods, in which one man handles from two to a dozen tools.

The Ephemera and the Aftermath

Much has been said as to the "wildcatting" of machine tools in this country. It is undeniably true that during the past months, numbers of inferior lathes, drilling machines, boring machines, grinders, turret lathes, etc., have been sold across the water, and that irresponsible concerns are still manufacturing hastily gotten-up

J. B. DOAN
President National Machine Tool Builders' Association

and nearly worthless tools for shipment abroad. It is argued that these will exercise a ruinous effect upon our foreign market, breeding a distrust which it may take years to overcome. The logicians responsible for this theory quite overlook the fact that along with some proportion of poor and indifferent machines, we have introduced into European centers a much greater quantity of the best types made here. These, without spread-eagle boasting, are generally considered the best in the world. American quality of manufacture, American supremacy in design, are being impressed on foreign buyers as never before. For the first time they are realizing on a large scale the possibilities of the automatic, peculiarly a product of Yankee genius. Whether the wholesale introduction of this wonderful machine into their scope of calculations will prove a boomerang, resulting later in its being turned against us in the trade war, is a matter of speculation. Experience teaches that the chief result for a long time to come will be an increased market for the innovation.

It is well enough for our rivals overseas, made desperate and perhaps envious through contemplation of the gains we make while they waste their substance in mutual destruction, to talk of savage competition, price-cutting, and quantity production when peace returns. But in these modern days, prophecies must be backed by facts. As regards the reduction of wages among European workers and the resultant stimulus of poverty and ambition to recover what has been lost; such assumptions can be carried only to a certain point. Beyond that, they cease to be "frightful" and are merely bogey. As a matter of fact, millions of men will come home from the much-maligned trenches with a new and higher idea of their own worth to the state and an equally newer and higher conception of what proper housing, clothing and food mean. These things militate against the "lean wolf" theory, and that mightily. The lessons born of army discipline may prove of great worth in reorganizing the powers of production, but can they be compared with the lessons American manufacturers, the aptest scholars in the industrial world, have been learning all these months from necessity under her guise of opportunity? It may develop a man's constructive faculties to be compelled to devise a new cannon or gas bomb for emergency use, but one would sooner believe that another man, who has successfully solved at short notice the problem of doubling his factory production, has advanced a little farther. The goose step, the stern camaraderie of the trenches, may prove a potent factor in co-operation for wholesale manufacture; but who would measure such things against concrete experience in this same, actual business of manufacture on the grand scale?

Have Learned Great Lessons

"Even if our war profits were to be completely destroyed," declared a large machine tool builder recently, "we would still count ourselves as vastly benefited by our experience in quantity production at short notice. We have gained immeasurably in the art of factory management. The enforced study of space requirements, routing charts, packing and shipping

methods, and elimination of waste motion, has completely altered our ideas of getting the most out of our capacity. In learning how to handle a big volume of orders in a short time, we have also learned how to handle a normal amount of orders at a great saving of overhead costs. This is also true of many other firms in the machine tool business and other lines affected by the war; and will prove to be industrial salvation in the years to come."

A further argument tending to favor the United States in foreign competition is afforded by the unhappy national divisions of Europe; divisions arbitrary and indifferent to the geographical and geological grouping of the war-torn continent. The three principal iron and machinery centers of Europe are situated as follows: in England, Sweden and Norway; in northeastern France, Belgium and some of the Rhine provinces of Germany, and in a district comprising parts of Silesia, Poland, northern Austria, Hungary and western Russia.

In these groups, coal and iron are favorably situated for large production. No matter what new boundaries are established on the conclusion of peace, they will still be where they are now. But it is extremely unlikely that any new distribution of territory will do away with the unfortunate cleavage lines which cut through these fields and subject them to the detrimental influence of customs duties and political and racial enmities. These latter, persisting long after the war, will divide European industry against itself as before, and to a greater degree. Many leaves will fall before manufacturers of the countries now at swords' points will feel as willing to buy equipment from one another as from the great neutral across the Atlantic.

That our home machinery market, long in a state of depression, will experience a renaissance in prosperity is the opinion of many men whose views carry weight. "Anxiety has been created in the minds of various consumers of railway equipment, machinery and general iron and steel products," says John A. Topping, chairman of the Republic Iron & Steel Co., Youngstown, O., "that increasing demands for war supplies suggest danger in further deferring of purchases; and a buying movement of substantial proportions is under way. Further improvement in volume is in sight. Manufacturers of implements, automobiles and other fabricators of iron and steel products who were indifferent to purchases at prices below present levels, are showing a keener interest in future supplies at present market levels".

William Lodge, president of the Lodge & Shipley Machine Tool Co., Cincinnati, is optimistic over the future of the home market, and is inclined to rate it as of even greater importance than the foreign field after the war. Mr. Lodge advances interesting reasons for his opinion. "The machine tool industry," he declares, "is entering a new era with the rapid development of high speed steel and the automatic tool. It is inevitable that a new competition will be evolved in which manufacturers who cling to the older types of tools will be displaced from the field. Those who plan to keep up with the procession will be forced to send their antedated machines to the cupola and refit with the latest types and methods. High speed, quantity production is to be the order of the day.

Domestic Demand

"The railroads, which for several years have made no showing in the market, will probably purchase a large amount of equipment as soon as the cessation of European and other munitions demand permits of a more settled price basis. The automobile industry will continue to grow on a large scale, and will need an ever-increasing number of machine tools. Other manufacturers in many lines will avail themselves of their opportunities immediately after the war to buy the tools they have long needed but have felt constrained to do without.

"As to the foreign market," declares Mr. Lodge, "we need entertain few fears on that score. American prestige is too well established at home and abroad to be seriously weakened by the efforts of its rivals. Furthermore, in my opinion, Europe will have its hands full with the task of renovating its impaired industries. Manufacturers on the other side, if they hope to take an active part in the world competition they herald, will face the same need of developing a rate of production commensurate with the modern advance of automatic machinery as exists here, the problem being even more elemental in their case."

A sanely courageous viewpoint, though scarcely a jubilant one, is that taken by J. B. Doan, general manager of the American Tool Works Co., Cincinnati, and president of the National Machine Tool Builders Association. "I do not feel," says Mr. Doan, "that we can reasonably anticipate any great development of the home market after the hostilities cease. This business is not a new one; the country has long been covered with a network of agencies, through which anyone desiring tools could be readily supplied. There will doubtless be a certain amount of domestic purchasing when prices return to normal, which has been postponed until that time. But it is to a world market that we must look for our real future prosperity. Now, I do not mean to say that American machine tool builders will 'capture' world trade. That is a word which has been cruelly overworked and misapplied, one which deserves a rest. But we are better prepared than ever to assert our presence in the European field, where our prestige, always excellent, stands higher than ever before, thanks to the missionary work our products are doing in fields where they were previously but slightly known. We must first rely upon the superior quality of our tools, and secondly upon good salesmanship, in the coming battle of commerce.

"It is fallacious to expect that the greater proportion of machine tools now in Europe will be worn out by the usage they are receiving. We must logically assume that most of them are being at least fairly well maintained. The return of the workers from battlefield to shop will mean, after an interval for readjustment and resumption of business, a formidable competition for us. I believe that the experience of army life will cause many toilers to demand better living conditions and accordingly, higher wages. But, after all, they must work for the wages obtainable and we must prepare to meet them on their own ground, and, to no small extent under their own conditions. In this country, the coming of peace will probably inaugurate a period of more or less depression in the machine tool business. In all likelihood, not a few cancellations of contracts will occur; and those firms which are not soundly financed will do well to set their house in order for such an emergency. Those who lack the necessary sinews to stand the losses attendant on possible cancellations will go down; and the effect will be far from beneficial for others strong enough to survive. But I feel confident that after a period of dull times, machine tool builders of the United States will take up the task of extending their sales, and that the ultimate effect will be to entrench us more strongly than ever in the markets of the world."

E. C. Henn, general manager of the National-Acme Mfg. Co., Cleveland, is inclined to the belief that after the war, most of the machine tools in Europe will need replacing,

and that American builders will be called upon for a large share of the new tools required. For this reason, Mr. Henn feels that the situation for some time to come will present few difficulties. H. W. Kreuzburg, president of the Champion Tool Works Co., Cincinnati, takes an opposite view, declaring that the market both at home and abroad will be seriously impaired. Prophesying a glut of machine tools throughout the manufacturing world, he considers the prosperity induced by war orders to be a false one, and that the demoralization of trade caused by overproduction and activities of impromptu manufacturing concerns will continue for some time.

To back his contention, Mr. Kreuzburg cites the case of our railroads, which, though expected for a long time to renew their equipment, have managed to get along with the same tool capacity for more than seven years. "Booms such as this one," asserts Mr. Kreuzburg, "are always followed by periods of depression, which infallibly prove more far reaching than the inflations which caused them."

"It is now hardly possible to divide the business of the United States into two classes—one favorably affected by the war, and one unfavorably affected, or not affected at all by the war," declares Frank A. Scott, secretary and treasurer of the Warner & Swasey Co., Cleveland. "The ramifications of the war's effects are so extensive that they can no longer be distinguished from other trade movements. As to lines of business indirectly affected by the war, it is well known that the war came at a time when American business was at a very low ebb. The war business has merely filled in the gap created by a diminution in American demand. There appears to be no reasonable doubt that American business generally is now experiencing a normal extension, and there are certain factors now absent from the market, particularly the railroads, which are exceedingly potent in stimulating demand when they are in the market. These factors are certain to enter the market within a short time and may safely be relied upon to absorb a considerable amount of the increased production of American mills and factories.

"A great impetus has been given by the war to American financing in foreign fields and American sales development in foreign fields," adds Mr. Scott. "Both these factors will be important in assisting to assimilate the increased quantity of American goods.

"War has in almost every instance been followed by stimulation and development in manufactures and commerce. In our own country this was particularly marked in the decade of the Civil War, 1860 to 1870, and the probabilities are that the present war will be no exception to this general rule.

"As to the 'after-the-war' effect on those plants which are producing what is distinctly war material, it now seems clear that unless the war lasts until all of the nations involved are entirely exhausted, there must be and will be a period of extensive preparation for possible further war by certain of the nations now involved, and by many neutral nations. It will naturally result that war munitions plants will simply transfer the service of their facilities from those now commanding them to the countries next in need of them. There is every probability that our own country will have to be a large purchaser of war munitions, for the public sentiment of the nation seems to have decided in favor of a greater degree of military preparedness."

F. A. SCOTT
Secretary-Treasurer, Warner & Swasey Co., Cleveland

Arguments both for pessimism and optimism may be deduced from the labor situation. On one hand, we have the spectacle of skilled workmen in numerous plants changing employers for the sake of a few cents extra pay. Accustomed as these men are to the factories in which they have long been employed, their loss necessitates the duplication of effort in "breaking in" numbers of new men to the same routine; and the general effect must tend to lower the efficiency of manufacture. This may be considered as offset to a considerable degree by the improved operation methods devised to meet large demands, methods which include not only new machine practice, but also the better handling of routine problems. Thanks to the widespread adoption of the separate bonus system, it seems probable that the return of labor to normal wage conditions after the war will not be attended with serious disorders.

Factors for Improvement

It must be borne in mind that in many cases, increased production has come not as a result of added space and machinery investment so much as of slight changes in equipment, such as dies, jigs, taps, etc., and in routine management. Many manufacturers preparing to handle war orders, have designed factory additions which may be readily adapted to other lines of production suited to the needs of peace. Finally, inventive genius is already active in planning new fields of endeavor. Small tools for the home, the garden, the automobile; utensils, toys and a hundred other commodities are to be manufactured in quantity; missionary effort will be directed by small arms manufacturers toward the stimulation of interest in marksmanship as a phase of "preparedness"; numerous lines which in the past have been dominated by foreign imports, will become Americanized.

The situation at large may best be summed up in the words of Elbert H. Gary, chairman of the United States Steel Corporation:

"The total wealth of the United States, according to the last published figures, is more than one-fourth of the aggregate of all the nations and it is rapidly increasing. Many of us believe that we may become and remain the leading nation, financially, commercially and industrially, provided nothing unnecessary is done by our people to prevent. Personally, I do not agree with the statements which have been made that, at the close of the war, we may expect in this country a prolonged continuance of the great prosperity now experienced: especially if we do not have protection against the results of cheap labor and the impoverished conditions abroad, which are inevitable. I do think that, with wise administration and with the cooperation of the state and national governments, our industries will be able to recover from the injurious effects of the wars much more rapidly than those of any other country, and that within a few years we shall be more successful than ever before."

American Magnesite in California

THE WAR in Europe upset American industry in many directions and by no means left the iron and steel industry of this country unscathed. Hostilities had not been long in progress when we began to feel a shortage of both ferro-manganese and magnesite, materials essential to the manufacture of basic open hearth steel. Fortunately there are unlimited deposits of the latter material in California which are now being worked.

By George H. Manlove

AMONG the many interesting effects of the European war on the American iron and steel industry, the developments with respect to magnesite should not be overlooked. In this connection, considerable importance is attached to the successful effort of the American Refractories Co., Chicago, to maintain a supply of magnesite and magnesite brick for steel works' use when the shipments from Austria and Greece were interrupted.

Magnesite suitable for open-hearth furnaces occurs in commercial quantities in only a few isolated portions of the globe, one of these places, fortunately, being California. It is also found in Austria and Greece. The cost of transportation across the continent from California to the steel-making centers of the east and middle west, in normal times, is greater than the ocean freight across the Atlantic. Therefore practically all the magnesite used in this country has been imported from Austria, where large deposits exist. A freight rate of $4.20 per ton sufficed to bring the material from Austria, compared with $10 per ton from California; this alone was sufficient reason for using the foreign material rather than that produced in this country.

In addition it must be borne in mind that the material brought from Austria is in a finished state, while merely the raw product is shipped from California, yielding only about 45 per cent of finished magnesite. This makes the freight equivalent to $22 per ton of calcined magnesite.

War Stops Imports

This was the situation existing when the European war started. Military developments soon placed the works of the Austro-American Magnesite Co., at Radenthein, Austria, in a position where no more material could be sent to this country.

The American Refractories Co., which handles the output of the Austro-American company in this country, then turned to Greece for its supply and for a time obtained the raw magnesite from that source. The war soon extended in that direction and eventually cut off the Grecian supply. Before this had happened officials of the American Magnesite Co. anticipated the trend of events and cast about for some means of maintaining the supply of magnesite and brick for steel works in the United States.

This material is one of the most necessary factors in the production of open-hearth steel and with steel producing interests working under great pressure a sure supply is an important consideration.

As much of the Grecian magnesite as possible was shipped to this country before the embargo became complete and the addition of bonding material produced a magnesite similar in analysis and physical appearance to the Austrian product. This was made into bricks and burned and also crushed into the product known as grain magnesite.

At the outbreak of the Balkan troubles, when it was seen the supply from Greece would be shortly cut off, arrangements were made for obtaining material from the California deposits, the supply in that state being inexhaustible. Calcining the

(*Continued on page* 103.)

CLEARING A ROAD INTO A CALIFORNIA MAGNESITE DEPOSIT

AFTER A BLAST IN A CALIFORNIA MAGNESITE LEDGE

TAKING OUT MAGNESITE BY TRAM CAR

State Socialism and Our Navy

BECAUSE the government's shipyards have the ability to conveniently "forget" a large number of expense details which in any other business plant would go into actual construction costs and overhead, they are able to outvie private enterprise in bidding on the proposed greater navy. The private yards are rapidly growing disgusted and are not keen on facing this unequal competition; the outcome holds no little danger.

By L. W. Moffett

THE five-year ship building program which has been recommended to congress by Secretary of the Navy Josephus Daniels, will call for approximately 407,650 net tons of structural steel, and 108,820 net tons of armor plate, making a total of 516,470 tons. His final recommendations propose a somewhat larger navy than that which was outlined in an earlier informal estimate. Of the grand total of $502,482,214, which Mr. Daniels states would be required to carry out the entire five-year plan, $69,932,790 represents the cost of armor and structural steel necessary for 10 battleships and seven battle cruisers. This figure is based on the cost of both classes of material for the last two battleships awarded, Nos. 43 and 44. The structural material alone for this type of vessel and the battle cruisers will cost $21,324,890, and the armor will cost $46,607,900. The battle cruisers, an innovation for the American navy, will require the same kind of material as the battleships, the amount of armor for each cruiser being less than half of what is required for a battleship. The quantity of structural material for such a cruiser will be about 5 per cent more than that needed for a battleship.

Structural steel tonnage will be distributed practically as follows, if the recommendations as suggested are adopted:

	Net tons.
10 battleships	160,250
Seven battle cruisers	117,775
10 scout cruisers	50,000
50 destroyers	15,000
15 fleet submarines	6,750
85 coast defense submarines	36,125
Five gunboats	2,250
Two hospital ships	6,000
Four fuel oil ships	6,000
Two ammunition ships	5,000
One repair ship	1,500
Total	407,650
Armor for 10 battleships and seven battle cruisers	108,820
Grand total	516,470

In view of the steel tonnages involved in battleships 43 and 44, which, according to the tentative proposals of the navy department, will typify all dreadnaughts in the five-year program, the tonnages and cost for the 10 battleships and seven cruisers can be estimated with fair accuracy. Battleships 43 and 44, by reason of the fact that their hull construction will provide against torpedo attack, call for approximately 100 tons more apiece of plates than was necessary for California, now building in the Brooklyn navy yard. In other respects the battleships will be almost identical with California. With the cost involved in craft other than the battleships and battle cruisers, the total for steel will probably run close to $100,000,000 for the entire five-year program. Incidentally, this is the amount of revenue the administration thinks it could raise if congress adopts the proposal to place a tax of 25 cents per ton on pig iron and fabricated steel.

Aside from tonnage to be used for armament and munitions, the army plans as recommended by Secretary of War Lindley M. Garrison will not call for a great amount of steel. Most of that which will be necessary will consist of flat reinforcing bars, ½ to 1¾ inches thick, to be used for fortification construction work. It is proposed to spend $20,000,000 annually for fortifications, spread over a period of four years. No accurate estimate of the steel tonnage to be used in these fortifications has been made.

Tonnages Required

Structural tonnage necessary for the proposed 10 battleships provided that if they are of the same type as battleships 43 and 44, will be as follows:

Material.	Net tons.
Special treatment steel plates	24,300
Medium class steel plates	70,300
Nickel steel plates	24,020
High tensile steel plates	4,000
High tensile steel angles	60
Medium class steel angles	15,440
Medium class steel beams	500
Medium class steel ship channels	7,500
Medium class half rounds	120
Medium class flat bars	100
Medium class steel shapes	270
Steel rivets	9,550
Steel castings	4,000

The approximate amount of armor required, with the cost per ton, based on awards for battleships 43 and 44, is as follows:

Class of armor.	10 battleships.	Seven cruisers.	Total tons.	Cost per ton.	Total cost.
A	73,740	24,500	98,200	$425	$41,735,000
A-2*	4,010	1,960	5,970	486	2,801,520
B	2,900	945	3,845	460	1,768,700
C	630	175	805	376	302,680
Total	80,280	26,580	108,820	....	$46,607,900

*Turret.

The strength of the steel market was reflected in the bids submitted by makers direct to the navy department for battleships 43 and 44, after Secretary Daniels had rejected the bids of private ship yards for building the vessels, and had awarded contracts to the Brooklyn and Mare Island, Cal., navy yards. This marked not only the first time two battleships were simultaneously awarded to government navy yards but also the first time the department ever took bids direct for structural steel for battleships.

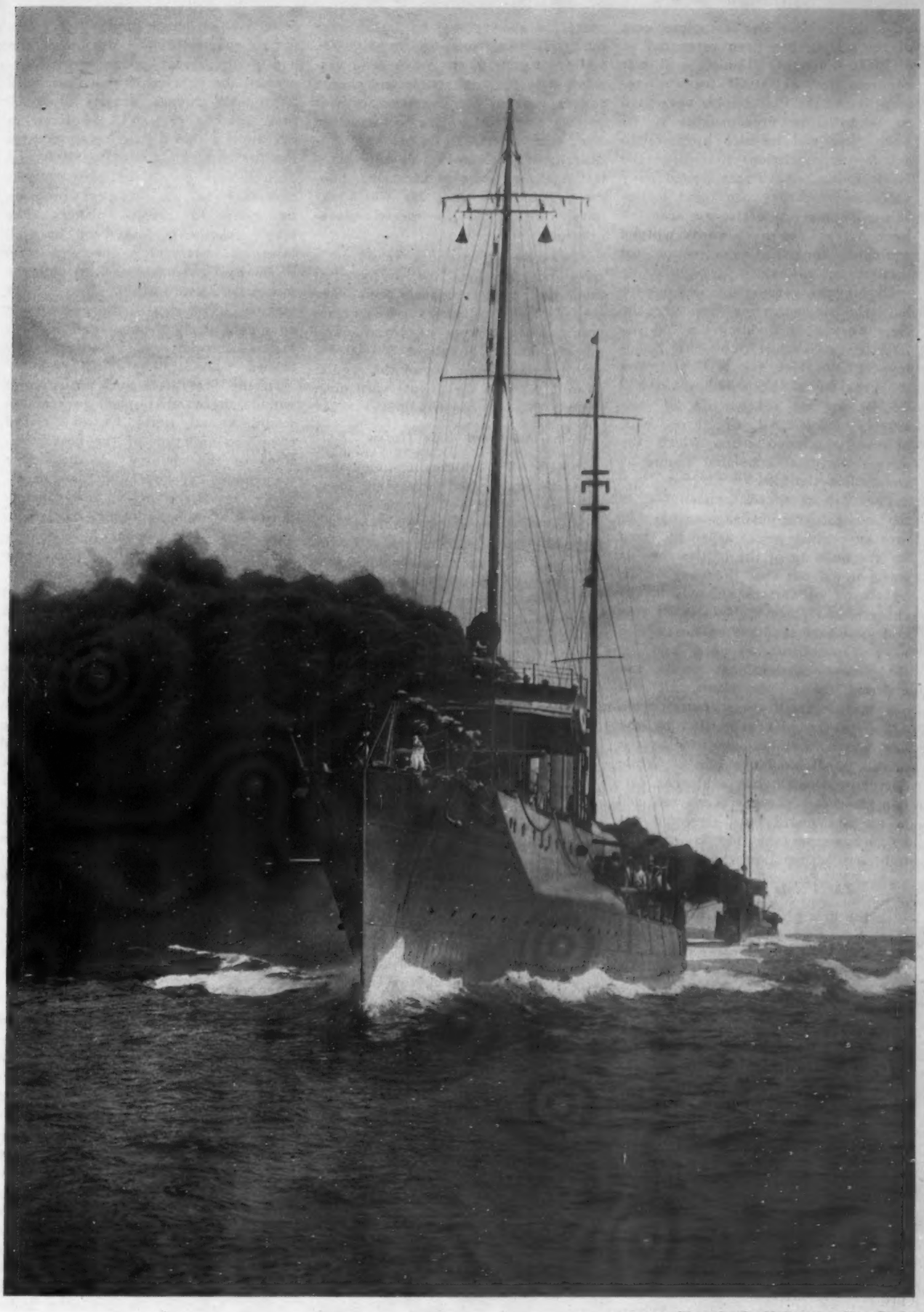
The awards, going to lowest bidders, were distributed as follows:

Contractor.	Pounds.	Total cost.
Carnegie Steel Co.	51,882,300	$1,680,777
Carbon Steel Co.	9,611,720	537,295
Pittsburgh Screw & Bolt Co.	*3,593,800	105,708
H. A. Wagner	* 228,000	25,365
Amer. Steel Foundries.	**1,836,800	110,208
	67,152,620	$2,459,353

*Rivets.
**Steel castings.

The cost of structural steel for one ship amounted to $1,229,677, as compared with $994,114, the cost of similar material for California, the last ship previously authorized, the award having been made about 15 months ago. The Carnegie company was the lowest bidder on classes A, A-2 and B armor, while the Midvale Steel & Ordnance Co. was the lowest on class C for the two ships. The structural steel bids were approximately 25 per cent higher for the two ships than those for the California. For California's armor, awards for classes A, A-2 and B per ton were $435, $486 and $466, respectively, as compared with $425, $486 and $460 for the two ships awarded in December.

Mr Daniels said that he was compelled to award contracts for the construction of the two ships to the navy yards because their figures were lower than those of private bidders, who, he claimed, exceeded the limit of $7,800,00 each, set by congress. The New York navy yard bid was lowest, at $7,069,925, and the Mare Island yard second lowest at $7,413,156. The former is the only yard at present capable of building a battleship. Included in the Mare Island bid was an item practically taking into account the cost of remodeling the shipways to prepare them for the construction



—*Photo by E. Muller, Jr., New York.*

DESTROYERS, THE ADVANCE GUARD OF OUR BATTLE FLEET

In case the United States were plunged into war what reliance could we place on government ship building plants to supply even enough additional destroyers, let alone battleships and battle cruisers? Where is the patriotism in the administration's policy of starving privately owned ship building and armor plate manufacturing establishments?

of a battleship. The complete cost of remodeling has been estimated at $500,000. Secretary Daniels will ask congress for $1,000,000 for the remodeling of the Philadelphia navy yard so as to allow dreadnaughts to be built there and he also proposes to ask for appropriations to enlarge the Norfolk, Va., and Puget Sound navy yards so that they can build battleships. If his proposals are accepted by congress, five navy yards will be equipped for the construction of battleships.

During the recent competition for battleship construction awards, the New York Ship Building Co. bid $7,700,000, the Newport News Ship Building & Dry Dock Co. $7,755,000, and the Fore River Ship Building Co. $7,299,500, for the construction of individual vessels. All of these bids, however, excluded items which the navy department stipulated should be included in the bids.

The private yards, shortly after the awards were made, gave out figures supporting prices asked by them for the building of the battleships. It was pointed out that the navy yards, by reason of various subdivisions of charges, can place the burden of several important expenses on the regular navy department accounts, and by that means government yards can underbid the private plants. It was also stated that if these charges were added to the bids submitted by the navy yards, the bids submitted by the private yards would be lower. While Secretary Daniels has said that certain overhead charges were included in the navy yard bids, they did not by any means take into account the full cost of building the vessels.

The Points of Difference

In the first place it has been shown that the private ship yard must pay for its drawings and plans, which, in the case of the battleships mentioned, amount to about $250,000. The navy yard need not take this matter into consideration, as this charge is provided for by special appropriation. Next, the private ship yard must pay about $125,000 for clerks, time keepers and other minor officials, while the navy yards do not charge this item to the building of any particular ship but take it out of the general expense account of the navy. Private ship builders must carry insurance and indemnity bonds, which cost about $100,000, while the navy yards need not give any bond for the faithful performance of contract, nor do they protect themselves by insurance against loss through accident. Private ship yards estimate that the cost of operating a completed battleship over the trial trip runs up to $100,000, while the government yards send vessels out to the trial course and charge the expense to the operation of war vessels and not to the construction cost, where it rightfully belongs. Another item that amounts to fully $350,000 is the expense of vacations, holidays, sick leave, etc., for which the navy yards secure a special appropriation.

The construction of a vessel in a navy yard requires the presence of numerous naval engineers who take the place of civilians in the private yard. The salaries of these naval officers amount to about $30,000 for each ship and come out of the regular payroll, whereas the private yard must charge this to construction.

Government Bids Unfair

Private ship builders contend that, while the navy yard figures are lower than theirs, it is well known that the bids of the government plants do not represent the total cost for a battleship, and it is on these grounds that the private plants are showing an inclination to forego naval work until the navy department officials come to a realization of the fact that it is quite impossible for private enterprise to compete with government yards under present conditions. Already the navy department appears to be worrying lest the navy yards will be unable to build the two battleships recently awarded without long delays, as is characteristic of government work.

Moreover, the bureau of construction and repair has announced that unless congress provides for 60 or 70 additional employes, the designing of the ships included in the administrations five-year program will be delayed six months or longer, and the construction of the ships themselves will be held up for that time. An estimate of $300,000, in addition to its usual estimates for office work, has been submitted by the bureau to cover the pay of additional draftsmen.

Not satisfied with plans to equip navy yards so that they can build all naval vessels, Secretary Daniels is continuing his efforts to have the government erect its own armor plate and projectile plant, while there is also an insistent demand by a certain type of congressman that the government should manufacture all its war munitions. The administration armor plate bill is already before the senate, having been introduced by Senator Benjamin R. Tillman, chairman of the committee on naval affairs. He hopes for its enactment into law before the end of the present month, and has expressed the belief that the plant, with a proposed annual capacity of 20,000 tons, can be erected and placed in operation within a year. He estimates that its cost would be $11,000,000, and desires that no armor plate awards necessary to the five-year program be given to private makers. The whole scheme is looked up by well informed observers as being a form of rampant commission, filled with the utmost dangers for the safety of the country. The idea of the government equipping itself to make all its war materials is impossible and therefore absurd.

In the first place such an attempt would mean that the government would at all times be an "armed camp" in violation of the best traditions of the country. With such a tremendous capacity built, there necessarily would be much idle capacity most of the time, entailing huge costs and waste that would have to be covered by extremely burdensome taxes upon the people. Secondly, private makers would be driven out of business, which would mean a calamity in times of war when the services of private industrial resources are urgently in demand to save the country from disaster. The present tax upon private industries in Europe to make war material is an emphatic example as to their usefulness and today England is paying dearly for her lack of encouragement to private makers in the past, and is working with might and main to mobilize all of her industries so as to bring them up to the highest possible point of efficiency. With these outstanding examples before the world, it is considered remarkable that, instead of giving encouragement to private industry, government ownership nostrums should be prescribed.

The Army's Recommendations

It is refreshing, however, to read recommendations made by the war department in this respect, sharply in contrast as they are to those of Secretary Daniels. The war department has recommended a plan to congress to place contracts with private munition makers without advertising for bids, in order to foster the development of plants deemed necessary in the general preparedness program. Not more than 25 per cent of the appropriations made for the ordnance department, which include the bulk of the total estimated in the bill, would, however, be available under this provision.

High Prices Bring Profits in East

THE CLOSE of the year 1915 found eastern mills crowded with orders taken at exceedingly remunerative figures, a complete reversal from conditions prevailing a year ago. Prices on many important rolled products, including billets, plates, shapes and bars have doubled. The revival obtained its first impetus from war orders, but the industry is now enveloped in a flood tide of business from domestic consumers.

By C. J. Stark

IN ALL the recurring tides of prosperity and of depression in the iron and steel trade of the United States, history never has known so swift and so remarkable a recovery as that of the year of 1915. Starting from the lowest stage of industrial activity since 1908, the swing of trade has mounted ever higher until it has attained a rate of production and of business volume long set before manufacturers as the goal of the generation. In the last quarter of the year, pig iron production reached an annual stride of 36,000,000 tons, while the yield of steel was at the rate of 38,000,000 to 40,000,000 tons and still the demand was not satisfied. Both iron and steel then were setting new high records for American industry.

While its European competitors for world's eminence in trade have been pouring out their economic life in a struggle of force, the United States has been following a practically uncontested path, buttressing its commercial future and material welfare with an unparalleled accumulation of wealth and resources. The balance of trade in its favor has run into the billions, securities long held by Europe as an annual tax in interest and dividends upon American enterprise are being bought back and in their stead, large loans for Europe and other foreign countries are being floated. The heavy export sales of iron and steel products and metal manufactures in a large measure are making possible this tremendous strengthening of the nation's business position. The export trade in iron and steel in 1915 broke all records and is estimated at about 3,600,000 tons or 600,000 tons ahead of the best previous year.

IN A LARGE part, the remarkable expansion of the American iron and steel industry has fallen within six months. During the first half of the year, general conditions were not materially altered from the dull times of 1914. Domestic trade, if anything, was more sluggish, but this was compensated for by the growing volume of business directly or indirectly arising from the war. After the turn of the half year, however, export shipments against earlier orders reached large proportions, the stream of new foreign business grew beyond bounds, and, genuinely domestic trade awoke with surprising rapidity. In these months, there were some abrupt accelerations of the general improvement which attained its maximum breadth during the last quarter.

The development of the great iron and steel market of 1915 has come so rapidly and has been the outgrowth of such unprecedented conditions that the question of its permanency remains to be answered by the future. It is indisputable that the restoration of expansive activity to the industry received its original impetus from the realignment of the world's trade in iron and steel caused by the war and from the direct necessities peculiar to the great conflict. The thorough upbuilding of the nation's industrial strength, financially, if in no other way, as the result of the present productive activity, points the way to the permanent salutary effects. A sound position of the railroads after their recent lean years, as an outcome of the immediate prosperity, is fraught with possibilities of greater stability for the iron and steel trade.

Munitions Steel Demand Heavy

One of the extraordinary features of the finished steel market in the east principally and throughout the country has been the tremendous demand for large steel rounds and for forging blooms suitable for the manufacture of ammunition shells. It is estimated that the orders placed for this class of material for delivery chiefly through the last half of 1915, and during the first half of 1916, have totaled 1,500,000 to 2,000,000 tons. This demand has ranged from what commonly are known as shrapnel sizes or approximately 3¼-inch rounds to 6, 7, 8 and 9-inch blooms, the latter for high explosive shells. The purchasing of this steel was both for export to munition makers in Europe and by manufacturers in this country who had taken up the production of shells for the belligerent nations. All the entente powers were heavy buyers and many of these orders were placed through J. P. Morgan & Co. French munition works, especially, bought freely and the orders for that country were probably 500,000 tons. Some of the countries not in the war, including Roumania, Greece and Spain, also were buyers. Especially attractive prices for the makers ruled on these forms of shell steel after the first few sales, when as low as 1.65c, mill, was done. The larger orders and the bulk of the tonnage booked by the mills in this country was under 3c, mill, but some lots especially toward the close of the year, when makers had sold heavily against their capacity, were taken at 3.50c and 3.75c, mill, while 4c, mill, was paid for rounds cut to length.

Finished steel prices in the eastern Pennsylvania manufacturing field practically doubled themselves in 1915. From a minimum of 1c to 1.05c, Pittsburgh, the market for plates and shapes rose to at least 2c, Pittsburgh, with sales for early or fixed delivery bringing $5 more. This represented a gross advance of $18 to $25, per ton. Steel bars except on large rounds, for which the demand was special, did not show the same advance relatively as other heavy products in the east, though quotations in December of 1.959c, Philadelphia, or 1.80c, Pittsburgh, a $14 per ton rise in the year,

largely were nominal because makers were months behind on their orders. Blue annealed sheets went from 1.45c, Philadelphia, for No. 10 gage, to 2.559c, Philadelphia, or a rise of $22 per ton; bar iron, from 1.15c Philadelphia, to 2.059c, Philadelphia, a jump of $18 per ton; open hearth rolling billets, from $20.50 to $38, Philadelphia, and forging billets from $25 to $55, Philadelphia.

There was no improvement in the volume of orders until in March and then it was but slight. The effect of this modest betterment, an active ship building market and the appearance of large foreign inquiries for ammunition steel and other war supplies, produced in April a $1 to $2 advance in plates, shapes and bars. A steady gain in the volume of the market and in mill operations continued up to August without any appreciable change in prices. Then the cumulative strength of conditions with an ever-increasing demand for direct and indirect exportation both in war supplies and in other products for which the war created a demand in this country, began to assert itself. Plate, shape and bar prices, in August, rose $2 a ton, remained steady in September, rose $2 to $3 in October and $3 to $4 in November. By December, the market had reached so high a point domestic trade had been so stimulated and bookings were so heavy, taking up the capacity of eastern makers for from three to five months ahead, that selling largely took on a retail character. Buyers were forced to pay whatever price was asked for their needs and they paid it to whatever mill could accommodate them. Prices then lost all semblance of uniformity and varied with the individual maker in accordance with what material he could offer for sale. The highest mill prices in the east, which ruled in December, were 2.50c, Pittsburgh, for plates; 2.25c, Pittsburgh, for shapes; 2.25c, Pittsburgh, for steel bars; 1.90c, Pittsburgh, for iron bars; 2.60c, Pittsburgh, for No. 10 gage blue annealed sheets; $40, Philadelphia, for rolling billets and $55 to $60, Philadelphia, for forging billets.

Fancy Prices for Billets

Billet prices in the east during the last quarter of the year reached extraordinary levels due to the general shortage of semi-finished product throughout the country. They then were at $38 to $40, eastern Pennsylvania mill, for open hearth rolling and at $50 to $55, mill, for forging steel and the demand continued to exceed the supply. The high prices on forging billets were due to the heavy consumption of this grade of steel in the manufacture of shell cases. The first half of the year, however, had been a dull one for the makers and operations were light. From January to July prices fluctuated narrowly from $21.40 to $22.25, Philadelphia. In July, the Steel Corporation, anticipating the approaching shortage of steel, entered the market and swept it clean of all the surplus tonnage that then was available. Out of its total purchases of 125,000 to 150,000 tons, from 75,000 to 100,000 tons were obtained from eastern Pennsylvania makers, in some cases at the unusually low price of around $19, mill. The eastern market stiffened as the result of these sales and soon was at $25, mill. In August, it was $30 to $32, mill, in September at $34 to $38, in October at $36 to $38 and in November and December at $38 to $40. Considerable tonnage of billets for shipment to Europe apart from that for shell manufacture was taken by eastern makers during the year. The British were the principal buyers.

Bar Iron Picks Up

One of the features of the year has been the rejuvenation of the eastern Pennsylvania bar iron industry which had been severely depressed for several years. A number of plants long idle again became market factors when attractive prices appeared. In August, eastern bar iron makers who had been quoting at the mill for several years resumed the use of Pittsburgh as a basing point for prices. This contributed to a higher level of prices. The total rise in common bar iron in the east between Jan. 1, 1915, and Jan. 1, 1916, was about $18 a ton, or between 1.15c and 2.059c, Philadelphia. Just before the year closed, makers advanced to 1.90c, Pittsburgh, or 2.059c, Philadelphia, the highest price known in the eastern market in recent years, if not in history. Makers had liberal order books at the beginning of the new year and were making deferred deliveries.

The unprecedented wave of prosperity that has fallen to the ship builders of this country was an important factor in the upbuilding of the steel market for eastern producers, especially in plates. From 50 to 60 new boats were contracted for by a eastern ship yards and this produced a very large requirement of steel, estimated at not less than 150,000 to 200,000 tons. In addition, perhaps 100,000 tons were called for by naval work for the government. The marine market remains the most active in history.

Foreign rail orders taken by the mills of this country in 1915 reached proportions never before known, due to the curtailment of European sources of supply by the war, and were approximately 600,000 tons against 460,000 tons the best previous record in 1913. Russia, alone, took about 400,000 tons of 67-pound rails, of which the Lackawanna Steel Co. booked about 200,000 tons and the remainder went to the Steel Corporation, Cambria and Pennsylvania Steel companies. France bought 85,000 tons of 91 to 100-pound rails of the Pennsylvania Steel Co. South American roads did not buy as much as usual. These foreign orders helped to make the year the largest in rail bookings in several years. Total orders in 1915, as compiled by *The Iron Trade Review*, were approximately 2,600,000 tons. Domestic roads bought moderately during the first half but heavily in the second half, when the problem of getting delivery presented itself. The Pennsylvania railroad, because of prolonged negotiations over new specifications, did not place its order for 1915 delivery until in June, when 155,500 tons were distributed. It followed quickly in October, however, with its order for 1916 delivery, which amounted to 177,000 tons. This, with one exception, was the largest order placed by this system in 10 years. The New York Central bought about 140,000 tons. The Algoma Steel Corporation, Sault Ste. Marie, Ont., captured about 60,000 tons of business in this country for 1915 delivery, but shared only lightly in the 1916 orders, its principal booking being 17,000 tons for the Pere Marquette. The Illinois Central, which in March bought 35,000 tons of the Canadian mill for shipment in 1915, in October placed its 1916 requirements with the home mills.

The total reported contracts for rails in tons by months in 1915 were as follows:

January	200,000
February	150,000
March	160,000
April	65,000
May	140,000
June	225,000
July	240,000
August	145,000
September	325,000
October	590,000
November	150,000
December	200,000*
Total	2,590,000

*Estimated.

Equipment Orders Fair

Car and locomotive buying in 1915 was considerably heavier than in 1914 and not far from the movement of 1913 and 1911. It, however, was less than half that of 1912. It may be summed up as only a fair total. Contracts placed in 1915 according to carefully prepared statistics of *The Iron Trade Review*, called for about 110,000 cars, which compares with

about 70,000 in 1914, 125,000 in 1913, 235,000 in 1912, 125,000 in 1911, 140,000 in 1910, 190,000 in 1909 and 60,000 in 1908. The equipment market was very narrow during the first four months in the year, when less than 10,000 cars were placed. It got under way briskly in May and during the succeeding seven months the orders reached about 90,000 cars, with October the banner month, when more than 20,000 cars were placed. The high steel prices prevailing toward the close of the year operated to deter the railroads in placing orders for much-needed equipment because of the increased cost. A notable instance of this was the 10,000-car inquiry of the Pennsylvania railroad which, in the main, was held up.

The year was featured by some unusually large export orders. Russia was the principal buyer, closing for about 10,000 freight cars and almost 500 locomotives. France was an important customer in both cars and locomotives, as were Servia, Belgium, Cuba and other countries.

The number of cars, passenger and freight, ordered in 1914, as compiled from carefully-verified statistics given by months, is as follows:

January	2,500
February	4,000
March	1,100
April	1,500
May	18,000
June	17,000
July	9,500
August	3,000
September	9,000
October	22,500
November	11,500
December	10,400*
Total for the year	110,000

*Estimated.

Locomotive orders, it is estimated, were approximately 3,000, compared with less than 1,000 in 1914 and an annual average of about 3,600 for the past 14 years.

Fabricated steel lettings in the United States by months in 1915 with the total tonnage and the percentage of shop capacity contracted for, according to the statistics of the Bridge Builders' and Structural Society, were as follows:

Month.	Tonnage.	Per cent of capacity.
January	43,000	25
February	51,000	30
March	110,000	64
April	107,500	62½
May	105,000	61
June	138,000	80
July	148,000	86
August	146,000	85
September	115,000	67
October	134,000	78
November	180,000	105
December	150,000	87†
Total	1,427,500	69*

*Average.
†Estimated.

This compares with total lettings of 1,075,000 tons in 1913 or about 52 per cent of shop capacity.

Fabricated steel activity in 1915, though well ahead of 1914, was below normal by a considerable margin and had it not been for the heavy subway and elevated tonnage, principally for New York, and for the extraordinary wave of extensions which swept through plants engaged in the manufacture of munitions, the constricted condition of business would have been much more pronounced. Shop operations averaged 60 to 70 per cent of capacity. Building work throughout the year was comparatively light and the railroads, as a whole, were modest buyers. The eastern districts produced a larger proportion of the year's tonnage than usual. For Greater New York subway and elevated extensions, about 200,000 tons additional work was awarded, bringing the total placed for this construction during the past two or three years to 400,000 or 500,000 tons, with about 100,000 tons still to be closed. The American Bridge Co. received practically all the year's awards. Philadelphia placed about 30,000 tons of similar work, the larger part of which went to the McClintic-Marshall Co. Munition plant construction involved 150,000 tons or more. At Eddystone, Pa., alone, about 20,000 tons were placed and around Bridgeport, Conn., about 25,000 tons.

Fabricated prices advanced sharply in the year, especially during the last half, but they did not keep pace with the rise in mill values. The average advance probably was $10 to $15 per ton.

Pig Iron Responds Slowly

Pig iron conditions in eastern territory during the first half of 1915 were largely a repetition of the sluggish and unsatisfactory market of the preceding year. They were characterized by contracted buying and narrow price movements. The makers had cut their production materially to meet the necessities of the dull market of 1914. Nothing occurred in fundamental trade conditions during the first six months of 1915 to cause any material change in these policies and the market simply drifted without any pronounced tone or tendency. At the end of June, basic and gray forge, delivered eastern Pennsylvania, northern No. 2X, Philadelphia, and No. 2X, Virginia furnace, were selling at the same prices as on Jan. 1, 1915. Low phosphorus, however, under a special demand was $1.50 higher. The prices then were $13.50 for basic and $13.75 for gray forge, both delivered eastern Pennsylvania; $14.25 for No. 2X and $20.50 for standard low phosphorus, both at Philadelphia, and $12.50 for No. 2X, Virginia furnace.

In March, the monotonous trend of the whole eastern market was rudely shaken by a selling drive of Buffalo makers of large proportions. This was done at an unprecedented price of $12, furnace for No. 2X for the bulk of the tonnage, while $11.50 was accepted in some cases. All principal eastern consuming centers were swept by this attack and in a comparatively few days orders aggregating 350,000 tons had been gathered in by the sellers. These covered the estimated requirements of many consumers up to Jan. 1, 1916. The drive was conducted swiftly and quietly and the iron trade records few if any paral-

Average Monthly Prices of Raw and Finished Materials in the East During 1915

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Pig Iron:—												
Basic pig iron, eastern Pennsylvania	$13.50	$13.75	$14.00	$13.25	$13.50	$13.50	$13.75	$15.25	$17.25	$17.50	$17.75	$18.00
No. 2X foundry, Philadelphia	14.25	14.25	14.25	14.25	14.00	14.25	14.50	15.25	16.25	16.50	17.50	19.25
No. 2X foundry, Virginia furnace	12.50	12.50	12.50	12.50	12.50	12.50	12.50	13.00	13.50	14.00	15.50	17.00
Standard low phosphorus, Philadelphia	19.00	19.00	20.00	20.00	20.00	20.50	21.50	23.50	24.50	28.00	30.00	32.00
Standard gray forge, eastern Pennsylvania	13.25	13.25	13.25	13.25	13.25	13.25	13.25	15.00	15.25	15.50	16.50	17.50
Old Material:—												
No. 1 heavy melting steel, eastern Pa	10.00	10.50	11.00	11.25	11.50	11.50	12.00	13.50	14.50	15.00	14.50	16.00
No. 1 railroad wrought, eastern Pa	11.75	12.00	12.50	12.50	12.50	12.75	13.50	15.00	16.00	16.00	17.00	20.00
No. 1 heavy cast, eastern Pennsylvania	12.00	12.00	12.50	12.50	12.00	12.25	12.25	13.50	14.50	14.50	15.00	16.50
Rolled Products:—												
Tank plates, base Philadelphia	1.25	1.25	1.25	1.35	1.30	1.30	1.35	1.45	1.50	1.60	1.80	1.95
Structural shapes, base Philadelphia	1.25	1.25	1.25	1.35	1.30	1.30	1.35	1.45	1.50	1.60	1.80	1.95
Steel bars, base Philadelphia	1.25	1.25	1.30	1.35	1.35	1.35	1.35	1.45	1.50	1.60	1.80	1.95
Common iron bars, base Philadelphia	1.10	1.15	1.15	1.15	1.20	1.20	1.25	1.40	1.45	1.55	1.75	1.95
Open hearth billets, Philadelphia	21.40	21.40	21.55	22.00	22.00	22.25	25.00	30.00	36.00	36.00	38.00	38.00

lels to it, in its completeness or its rapidity. The actual period of the movement covered only three or four days.

The second half of the year stood out in sharp contrast to the first six months. Starting in July, the upward swing of the market asserted itself slightly at first but with increasing strength and activity as it proceeded. Basic, reflecting the growing expansion of steel works activity, was the first to feel the stimulus of the new order of affairs. From $13.50, delivered eastern Pennsylvania, in June, it advanced 25 cents in July; $1.50 in August; $2 in September; 25 cents in October; 25 cents in November, and 75 cents in December, selling at the year's close at $18.50, delivered, a net advance of $5 in the year. The Lukens Iron & Steel Co. was the largest eastern buyer. In April it closed for 59,000 tons; in June, for 30,000 tons; in August, for 20,000 tons; in September, for 45,000 tons, and in October for 58,000 tons. The last two lots were for first and second quarters of 1916. About 20,000 tons of southern Ohio basic were sold in the east in September. It was patent from the first that the improvement was purely on the steel side. From a practically steady level of $14.25, Philadelphia, for No. 2X, that had prevailed up to July, foundry iron moved slightly upward but with uncertainty. Quickly the unusual position of a basic price above that of foundry iron was shown. This condition continued through August, September, October and November and it was not until in December that by a $2 advance the normal relation of these two grades of iron was restored. Eastern Pennsylvania No. 2X then was selling at $19, furnace, or about $19.60 to $19.75, Philadelphia, while $20, furnace, was being obtained in an increasing number of transactions for various deliveries in 1916. The advance in eastern Pennsylvania foundry iron during the year amounted to $5.25 a ton. Gray forge followed closely the movement of foundry iron throughout the year. In January, it was heavy at $13.25, delivered eastern Pennsylvania. In December, it had sold at $17.80, delivered eastern Pennsylvania, and the demand, both from the puddling mills and the pipe foundries, was brisk. Prices for basic, foundry and gray iron in eastern Pennsylvania during December were the highest since 1910.

Low phosphorus iron established a position of its own in the year, in that its advance was the largest of any grade, ranging from $13 to $15 a ton, in quantity, while small lots brought several dollars more. These prices were the highest in the history of the manufacture of this grade in the United States. Standard low phosphorus was sold at $30, furnace, or about $30.60 to $32.60, Philadelphia. Lebanon brands commanded up to $32, furnace, and small sales were closed at almost $40, furnace. The heavy demand for munition steel, both in this country and abroad, together with the limited production of this grade of iron, due to the scarcity of suitable ores, were the main factors in the market's unusual strength.

Merchant iron makers in eastern Pennsylvania closed the year with from 500,000 to 550,000 tons of unfilled orders and with about 90,000 tons of stocks. The year before, orders were less than half as much and stocks about 110,000 tons. On Jan. 1, 1915, 12 merchant furnaces in eastern Pennsylvania were active. On Jan. 1, 1916, the number was 26.

Virginia Iron Comes Back

Virginia iron came into its own in 1915 and its position at the end of the year was the best since 1907. The rise in the market was from $12.50 to $18, furnace, for No. 2X. The recovery of sound and profitable conditions is illustrated by the present statistics of the district. On Jan. 1, 1915, total orders of the Virginia producers were only 35,000 tons and total stocks about 150,000 tons; on Jan. 1, 1916, total orders were about 300,000 tons, and stocks not far from 130,000 tons. On Jan. 1, 1916, seven Virginia furnaces were active, compared with three on the corresponding date a year previously. Virginia iron during the last half sold freely in New Jersey, New York, New England and other northern districts. It was aided in doing this by a reduction in freight, which made the rates $2.75 per ton to Philadelphia and surrounding points and $3 to $3.10 per ton to the upper New Jersey and lower New York state zone.

American pig iron makers sold metal to more foreign countries in the year than ever before but the total, which was about 200,000 tons, was not as heavy as in 1912 and 1913. Probably more steelmaking grades were sold abroad, however, than ever before. This iron was drawn largely from eastern Pennsylvania, Alabama and the Mahoning and Shenango valleys. Steelmaking iron figured chiefly and the largest buyers were France, Italy, Japan and Canada, with England and South American countries taking some tonnage. France bought bessemer, low phosphorus and basic; Italy, bessemer, low phosphorus and foundry; Japan, low phosphorus; England, bessemer and low phosphorus, and Canada, low phosphorus. Full domestic prices were obtained on most of the business taken. In December, Italy bought bessemer at $21, tidewater; Canada, standard low phosphorus at $30, furnace.

Old material prices followed the course of the pig iron and finished iron and steel markets though the advance in some grades was not so pronounced as in other products. Heavy melting steel, delivered eastern Pennsylvania, rose $6.50 a ton or from $9.50 to $16; No. 1 railroad wrought, $9 a ton, or from $11.50 to $20.50; No. 1 heavy cast, $5 a ton, or from $11.50 to $16.50. A scarcity of railroad wrought developed late in the year. Low phosphorus scrap also was scarce and advanced $8.50 or from $13.50 to $22, delivered. Foreign buying played some part in the market. Italy, which previously had drawn much scrap from England and from other European countries, was the principal buyer. Large lots of rail and ingot crop ends, steel axles and other rerolling stock were purchased in this country. High freights prevented the closing of a much larger tonnage. The government offered in the market some large accumulations of Panama canal scrap during the year.

The United States Steel Corporation

Record of Eastern Blast Furnaces

	1915.		1914.		1913.		1912.	
	Mer-chant.	Non-Mer-chant.	Mer-chant.	Non-Mer-chant.	Mer-chant.	Non-Mer-chant.	Mer-chant.	Non-Mer-chant.
Lehigh Valley	10	5	4	4	4	7	9	7
Schuylkill Valley	4	6	2	2	3	4	4	6
Lebanon district	5	5	2	2	4	3	5	6
Central Pennsylvania	5	0	2	0	2	0	4	0
New Jersey	1	0	1	0	2	0	1	0
Tidewater	1	3	1	1	1	2	1	3
Total	26	19	12	9	16	16	24	22
Eastern New York	2	.	.	.	.	.	.	.
Virginia	7		3		8		6	

practically doubled its order book in 1915, increasing it from 3,836,643 tons as of Jan. 1, 1915, to approximately 7,700,000 tons on Jan. 1, 1916. The unfilled orders on Jan. 1, 1916, were the largest since Jan. 31, 1913, and had been equalled only on three occasions since the plan of monthly announcements of business on hand was adopted. These were November and December, 1912, and January, 1913. The heaviest gains in 1915 were made in October and November, the latter being the largest with one exception, ever reported. At the beginning of 1916, the monthly steel output of the Steel Corporation was estimated at about 1,600,000 tons.

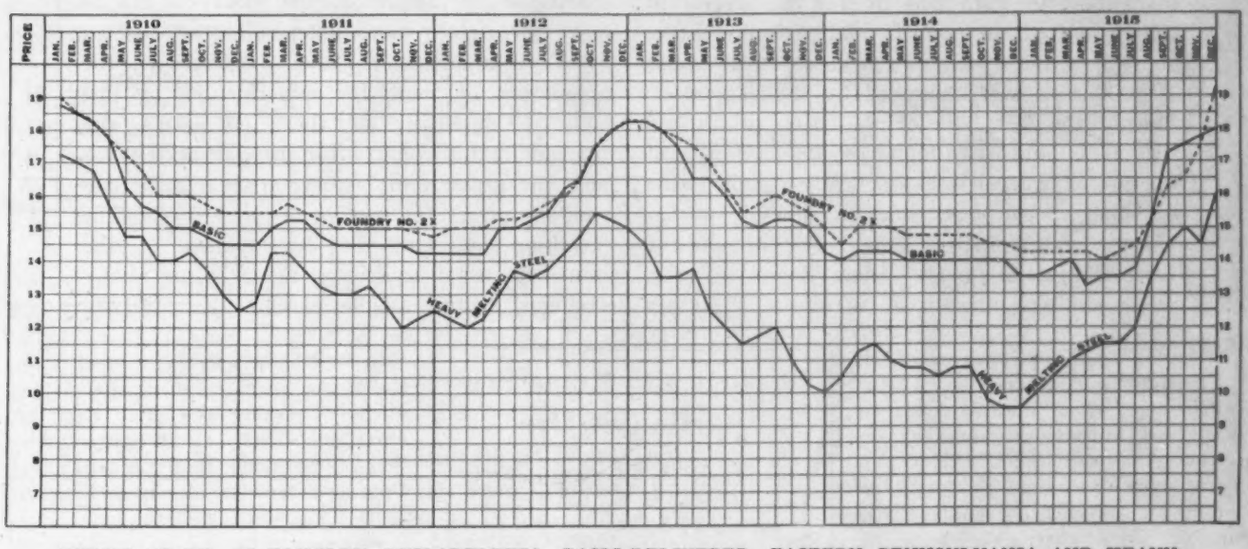
The following is the statement by months of unfilled tonnage during the year of 1915 showing the net changes:

Date.	Total.	Tonnage change.
Dec. 31, 1915.....	*7,700,000	500,000+
Nov. 30, 1915.....	7,194,489	1,024,037+
Oct. 31, 1915.....	6,165,453	847,834+
Sep. 30, 1915.....	5,317,619	409,163+
Aug. 31, 1915.....	4,908,455	20,085+
July 31, 1915.....	4,928,540	205,344+
June 30, 1915.....	4,678,196	413,598+
May 31, 1915.....	4,264,598	102,244+
Apr. 30, 1915.....	4,162,244	93,505—
Mar. 31, 1915.....	4,255,749	89,622—
Feb. 28, 1915.....	4,345,371	96,800+
Jan. 31, 1915.....	4,248,571	411,928+
Dec. 31, 1914.....	3,836,643	512,051+

*Estimated approximately.

Merger Talk

As a sequel to the high market and generally prosperous conditions prevailing during the closing months of the year, a large number of different propositions were launched for the purchase or amalgamation of eastern blast furnaces and steel works. The most important of these was the acquisition in September by a group of capitalists headed by ex-President W. E. Corey, of the Steel Corporation, of the properties of the Worth Bros. Co., Coatesville, Pa., the Remington Arms Co., at Eddystone, Pa., and the Midvale Steel Co. and their merging into a new $100,000,000 corporation, the Midvale Steel & Ordnance Co., which was chartered in October. Another group of capitalists in October and November obtained options on the blast furnace plants and ore mines of the Thomas Iron Co., Easton, Pa., of the Empire Steel & Iron Co., Catasauqua, Pa., and of the Wharton Steel Co., Wharton, N. J., with the purpose of their combination and the erection of a steel works in connection. A third project was the taking over and the rehabilitation of the plant of the Diamond State Steel Co., Wilmington, Del., which had been idle for 11 years, by a new corporation, the Delaware Steel & Ordnance Co., capitalized at $10,000,000, for the purpose of manufacturing munitions. This corporation also acquired the blast furnace of the Temple Furnace Co., Temple, Pa. In November, William H. Donner, president of the Cambria Steel Co. and chairman of the Pennsylvania Steel Co., obtained control of the New York State Steel Co., Buffalo, comprising steel works and a blast furnace and organized the Donner Steel Co., capitalized at $5,000,000, to put the plant in operation. There were other important negotiations under way at the close of the year, conspicuous among which, by reason of its magnitude, was the plan to which New York bankers were giving their support, for the formation of a new $250,000,000 company, to take over the Cambria Steel Co., the Youngstown Sheet & Tube Co., and perhaps the Lackawanna Steel Co. and other companies. Late in December, this giant project was assuming definite form.



PRICES OF NO. 2X FOUNDRY, PHILADELPHIA; BASIC DELIVERED, EASTERN PENNSYLVANIA AND HEAVY MELTING STEEL, DELIVERY EASTERN PENNSYLVANIA, 1910-1915

Equipment Catalog

The American Society of Mechanical Engineers has published its fifth annual condensed catalog of mechanical equipment. The present volume contains several new reference features, including a section of mechanical engineering data. These data are derived from the papers presented before the society during 1914 and from the foreign review section of the *Journal* of the society for the same year. A special section is devoted to catalog data from manufacturers of measuring and testing apparatus, this section being preceded by an introduction covering the development of the use of such apparatus in industrial plants in this country. The mechanical equipment directory contains over 1,500 different subject headings and names and addresses of nearly 500 representative manufacturers of all classes of mechanical equipment. This directory has been carefully compiled and thoroughly cross-indexed and is extremely useful in locating readily the names of manufacturers of any given product.

The oxy-acetylene process of welding and cutting metals is discussed in two publications issued by the Searchlight Co., Chicago, manufacturer of oxy-acetylene welding, cutting and decarbonizing outfits. In the first of these, a 16-page booklet, the company's apparatus is described and illustrated with numerous views of actual operations, such as repairing castings, cutting up old boilers, welding cylinders, bonding rails, etc. A 12-page treatise on acetylene gives the history of the process since its discovery, together with a description of the methods used in preparing acetylene.

Development of Ferro Manufacture

SELF-RELIANCE, taught by the vicissitudes arising from war emergencies, will probably be rated ten years from now as the chief good fortune which will accrue to us from our neighbors' strife. The history of ferro-manganese manufacture in the United States, a story the greater part of which dates since August, 1914, is here interestingly set forth in detail, illustrated with price charts and data compilations.

By C. J. Stark

IN PROBABLY no other material entering directly into steel manufacture have wartime conditions brought about such sweeping effect on the position of domestic supply and demand as in ferro-manganese and other high manganese alloys. The output of ferro-manganese in 1915 was by far the largest in the history of the country and probably three-fourths of the estimated consumption of about 200,000 tons were supplied by home product. During the last half of the year, production was at an unusually high rate. Domestic production of spiegeleisen practically equalled that of other recent years prior to 1914. In that year it was unusually low. The amount of ferro-manganese made from domestic ores, while still insignificant as to standard 80 per cent quality, was the greatest in years. This stimulus of home production has been due, primarily, to the severe restrictions surrounding the imports of this alloy from the usual foreign sources of supply, principally England, and by the unusually high market prices which sharpened the desire of the steel makers to make themselves more independent of foreign bases of supply and likewise encouraged the upbuilding of merchant manufacture of this metal. Consequent of these conditions, the demand in this country for manganese ore has been the greatest in history, producing record-breaking prices for foreign ore and stirring the searching out and the development of the limited domestic deposits as never before in the economic history of the nation.

THE GREAT European war has brought out sharply as it has done in many other lines of business, a surprising improvidence on the part of the American steel makers in relying upon European producers to supply an essential manufacturing material, when there has been no vital necessity for it. In the case of ferro-manganese, this has been conspicuously true for the reason that England, principally, and Germany, in a smaller way, which have furnished the bulk of the requirement of this country, have been making this alloy largely from imported ore, this coming from Russia, India and Brazil. As one of the lessons of the past year and a half, it seems safe to say that the making of ferro-manganese on a considerable scale in this country, both for the needs of the producer and for the market, has come to stay. The closer trade relations and the improved shipping facilities that have been built up the past year or so with South American countries seem to insure the marketing in this country of the greater portion of Brazilian manganese ore in the future. American steel-makers and merchant operators have shown their ability to make ferro-manganese and spiegeleisen equal in quality to the imported product. The difference in the cost of production in this country and abroad is not so wide as to discourage competition since in all cases imported ores are required.

Imports and Home Production of Ore

	Imports	Home Output
1915	200,000*	5,000*
1914	283,294	2,635
1913	345,090	4,048
1912	300,661	1,664
1911	176,852	2,457
1910	242,348	2,258
1909	212,765	1,544
1908	178,203	6,144
1907	209,021	5,604
1906	221,260	6,921
1905	257,033	4,118
1904	108,519	2,146
1903	146,056	2,825

	Source of Imports, Brazil.	Russia.	India.
1915	170,000*	.....	30,000*
1914	113,924	52,681	103,583
1913	70,200	124,337	141,587
1912	81,580	83,334	128,645
1911	41,600	19,103	106,580
1910	53,750	33,120	140,965
1909	35,600	14,486	145,140
1908	17,150	250	143,813
1907	52,922	1,000	95,300
1906	30,260	13,805	154,180
1905	114,670	24,650	101,030
1904	66,875	11,959	10,200
1903	76,910	5,576	35,900

*Estimated.

Prior to 1915, practically the only producer of ferro-manganese in this country, year in and year out, was the United States Steel Corporation. The tremendous annual needs of this important manufacturer made it imperative that it protect itself against market excesses by making its own requirements, almost entirely from imported ore. In 1915, no less than three independent steel companies put furnaces upon the making of ferro-manganese. These were the Maryland Steel Co., which supplied the Pennsylvania Steel Co. and other close interests; the Jones & Laughlin Steel Co., which first ran one of its Aliquippa stacks and later leased the Kittanning, Pa., furnace for this purpose; and the Colorado Fuel & Iron Co. Two or three other companies engaged in the making of ferro-manganese and spiegeleisen for the market, those being the American Manganese Mfg. Co., which controls the Dunbar, Pa., blast furnace; the Noble Electric Steel Co., of San Francisco; and the Electro-Metallurgical Co. of Niagara Falls, the last two by the electrolytic process. The New Jersey Zinc Co. has continued to be the leading domestic maker of spiegeleisen, using manganiferous zinc residuum for the manufacture of this alloy at its Palmerton, Pa., furnaces. Its output in 1915, was unusually heavy, to meet the large market. Late in the year, plans were completed for blowing in the Juniata furnace, at Newport, Pa., for the production of spiegeleisen from zinc residuum to be supplied by the New Jersey Zinc Co. The Steel Corporation has continued to be a producer of spiegeleisen, principally at South Chicago and at Ensley, but the amount has been growing less yearly, owing to the decline of the bessemer steel-making process

THE IRON TRA

CHARTS SHOWING FLUCTUATIONS IN IRON AN

Chart Showing Fluctuations in Iron and Steel

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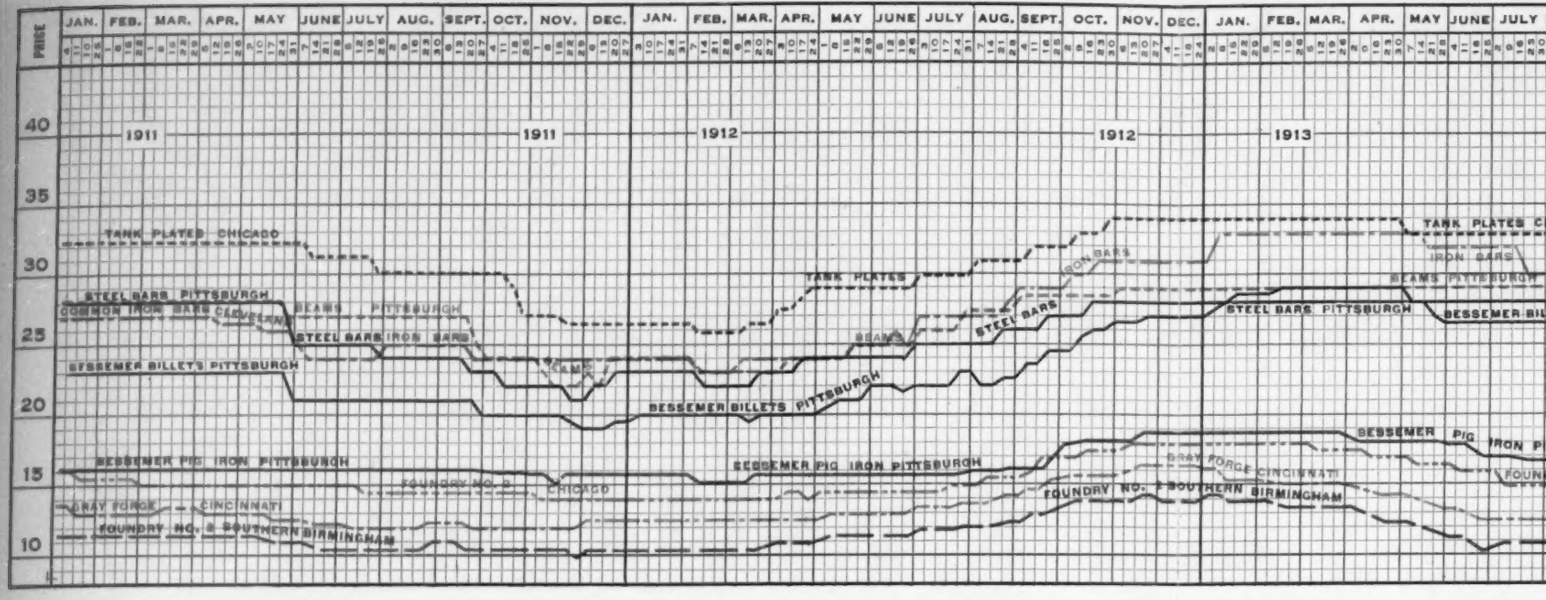

Fluctuations in Iron and Steel Prices for Sixte

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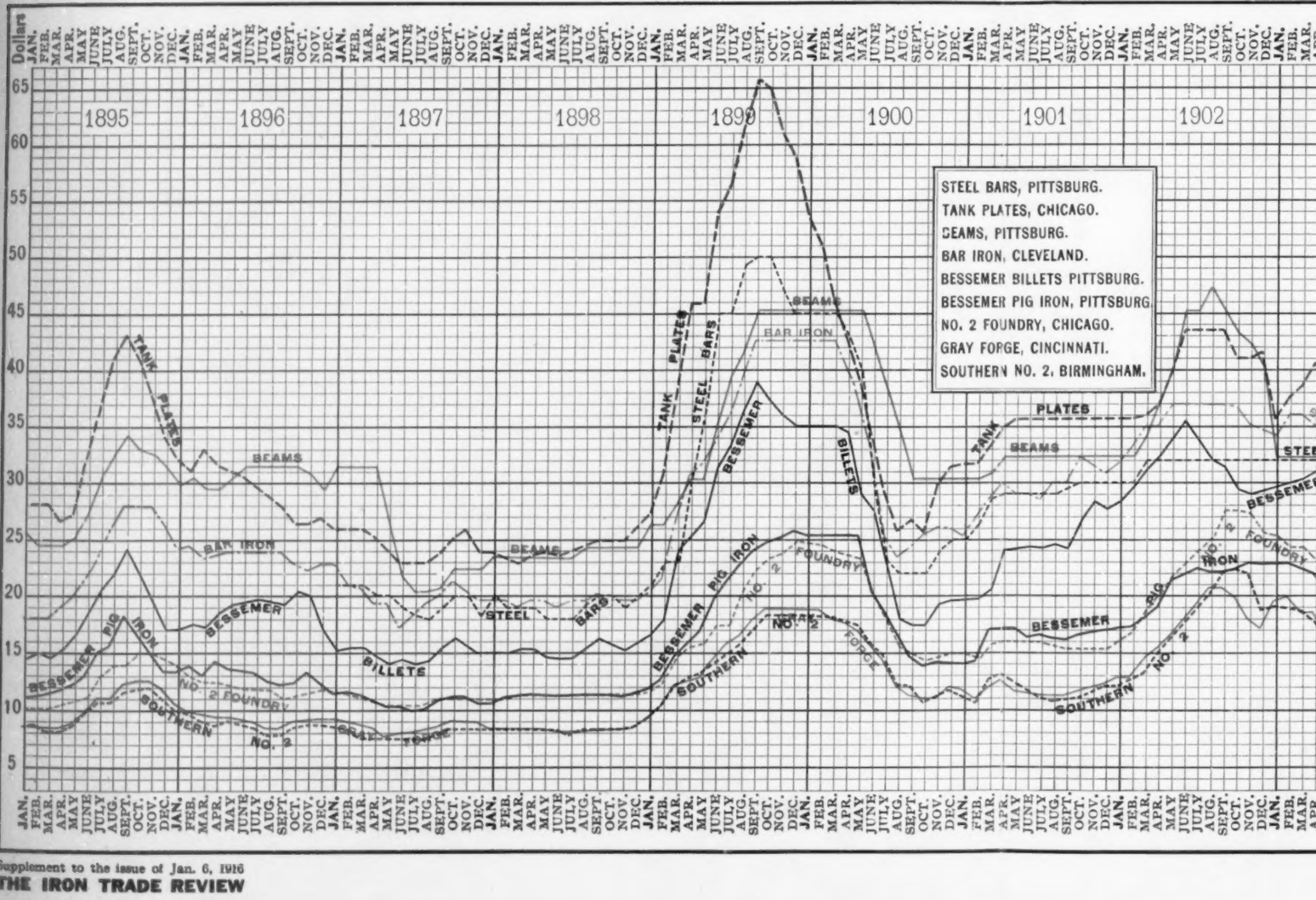
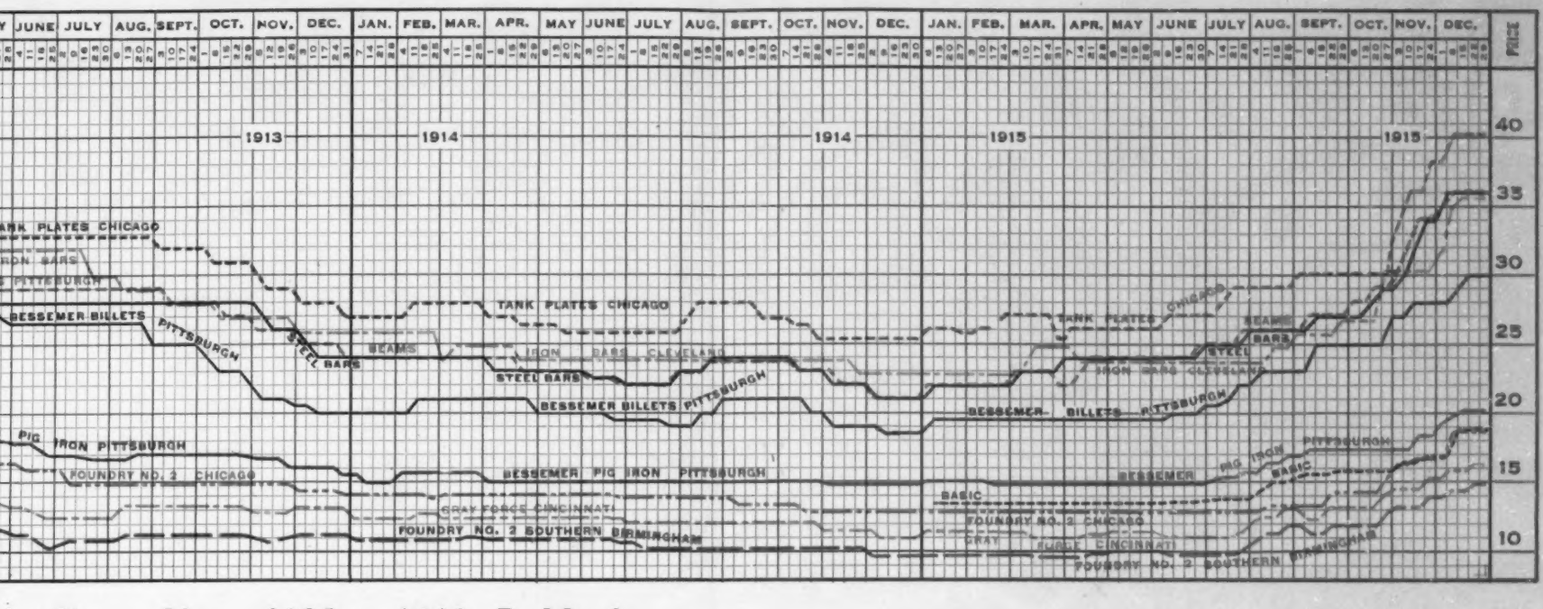


RADE REVIEW

N AND STEEL PRICES FOR TWENTY-ONE YEARS

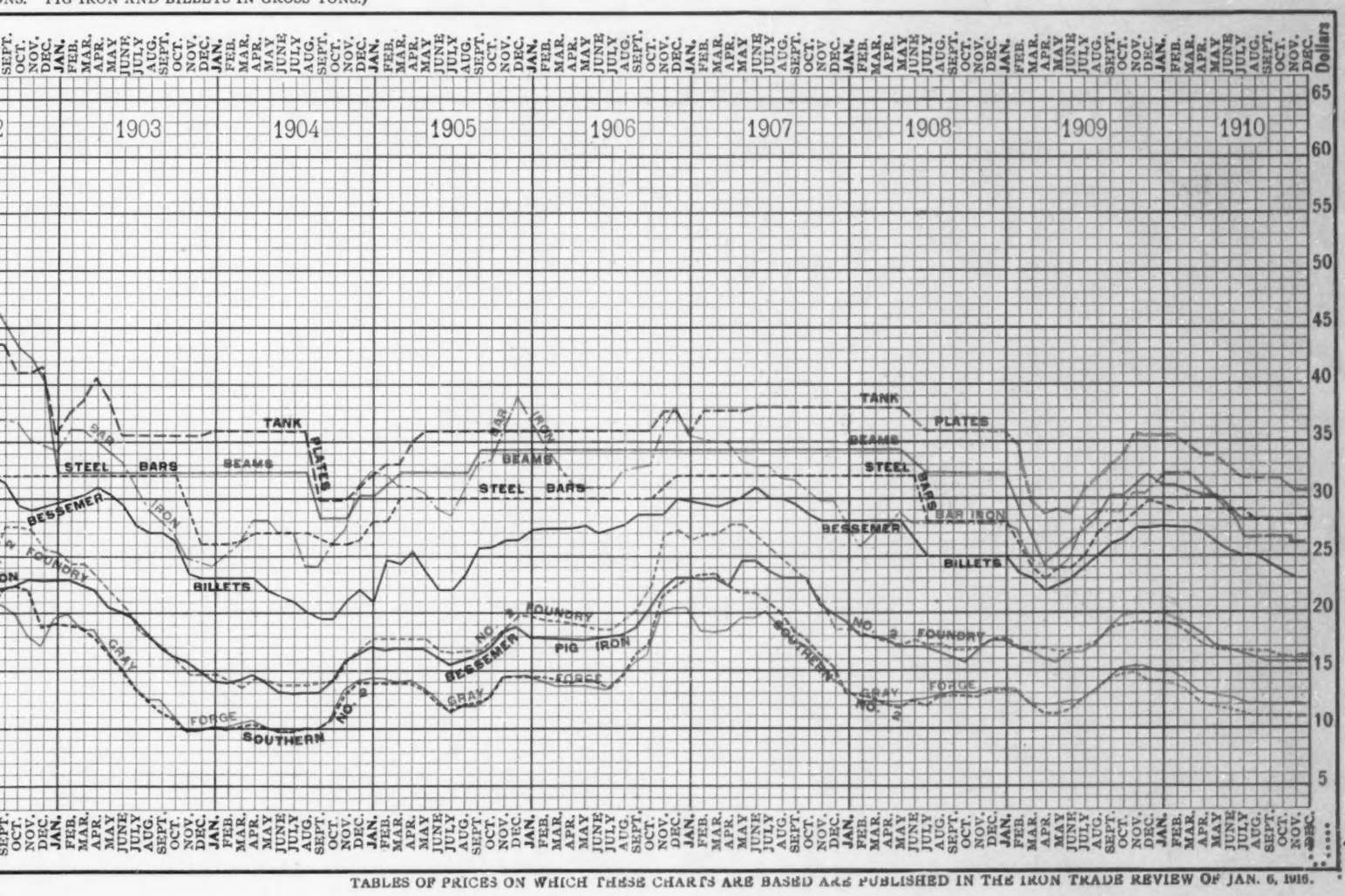
d Steel Prices in 1911-12-13-14-15 By Weeks

ONS. PIG IRON AND BILLETS IN GROSS TONS.)



for Sixteen Years—1895 to 1910—By Months

ONS. PIG IRON AND BILLETS IN GROSS TONS.)



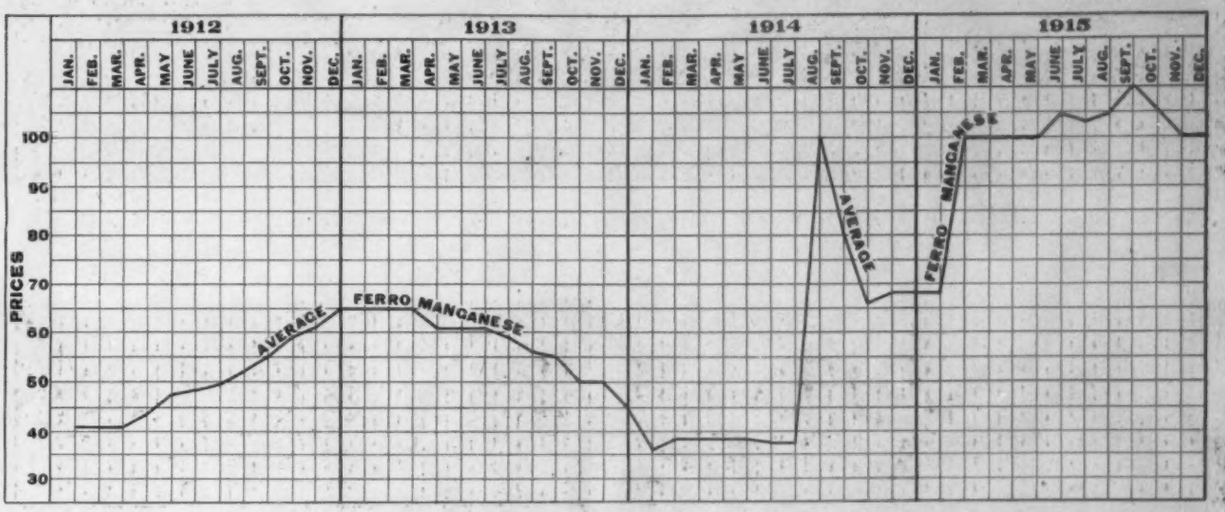
TABLES OF PRICES ON WHICH THESE CHARTS ARE BASED ARE PUBLISHED IN THE IRON TRADE REVIEW OF JAN. 6, 1916.

in this country. The exigencies of the market made this producer a large buyer of domestic spiegeleisen during the year. Some of the steel-company producers of ferro-manganese have been sellers at times during the past year of a portion of their output.

The output of ferro-manganese in the United States in 1915 was approximately 160,000 tons. Of this total, about 110,000 tons were produced during the last half of the year. The output of spiegeleisen in 1915 was approximately 105,000 tons, of which about 60,000 tons were manufactured during the last half. In 1914, the output was 100,731 tons of ferro-manganese and 106,980 tons of spiegeleisen; in 1913, 119,495 tons of ferro-manganese and 102,561 tons of spiegeleisen; in 1912, 125,378 tons of ferro-manganese and 102,561 tons of spiegeleisen; in 1911, 74,602 tons of ferro-manganese and 104,013 tons of spiegeleisen; in 1910, 71,376 tons of ferro-manganese and 153,055 tons of spiegeleisen. The average annual domestic output of ferro-manganese for the past ten years has been about 88,000 tons and of spiegeleisen about 143,000 tons.

An Uncertain Market

The market in the year has been beset with peculiar conditions and these still largely prevail, due to the elaborate efforts which the British government has made to prevent any of its exported ferro-manganese from directly or indirectly benefiting the enemies of itself or of its allies. When the year opened, practically no ferro-manganese was being imported, as the British admiralty just had announced the procedure under which the legitimate needs of consumers in this country would be supplied by new purchases or against unfilled contracts. This provided that formal written guarantees should be given by each buyer pledging that the ferro-manganese delivered to him would not be re-exported to the enemies of Great Britain and her allies or to contiguous countries, nor that any steel into the manufacture of which this alloy entered should be exported to Germany, Austria, Turkey or adjoining territory. Later, it was stipulated that unfilled portions of contracts, many of which were made at $35 to $38, seaboard, in 1914, should be merged with equal tonnages at the then market price of $68, seaboard. Though there was some opposition, consumers generally subscribed to these terms and guarantees. Licenses for about 5,000 tons monthly were granted in February, but importations were not resumed until March. The market in January nominally had been $68, seaboard, though there were no sales at this figure. Spot material soon began to command premiums and in February, up to $100, Pittsburgh, was paid for domestic material. When shipments were resumed, English makers on March 3, fixed the prices for new purchases for shipment as they were able, at $78, seaboard. Spot material sold at $90 to $100, seaboard, with domestic makers active in the market. On April 30, the English price went to $88, seaboard. On May 14, this figure was withdrawn and $100, seaboard, was substituted. The market remained around this level for three months. By June, the increasing operations of the steel works were felt in the market and spot metal sold at $115, seaboard. Shipments from England then were running about 5,000 tons monthly. Rumors began to appear that the British government, finding its own supplies impaired because of reduced ore shipments from India and elsewhere, proposed to embargo the exportation of ferro-manganese. It finally developed that the British authorities were demanding of their makers that they accumulate not only a three-months' stock of ore, but also of smelted product before they would be permitted to ship from England. The result was that shipments slumped off after Aug. 1, and as the steel output of the country had risen to large proportions, the highest prices of the year were paid for spot and early metal. The top point reached by carload sales was $140, seaboard, which was the highest price since the Russo-Japanese war. After some delay, shipments from England again were resumed in October but they continued irregularly up to the year's close. In October, about 3,000 to 4,000 tons were imported and in November, about 4,500 tons. October prices turned slightly soft and $100, seaboard, was shaded several dollars in occasional transactions. The market then tightened and was steady in November and December.



PRICES OF FERRO-MANGANESE, TIDEWATER, 1912-15

Average prices of ferro-manganese at eastern seaboard, based on actual sales for the past four years, have been as follows:

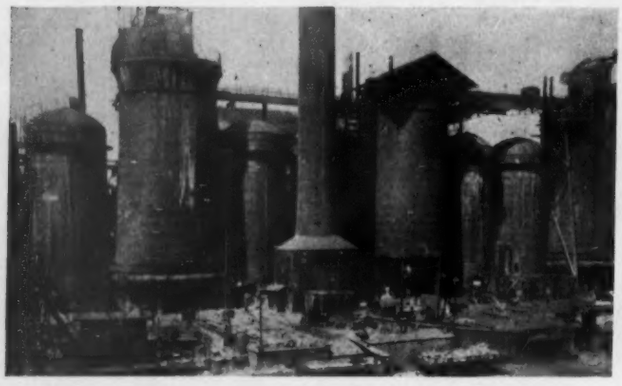
	1915	1914	1913	1912
January	$ 68.00	$36.00	$65.00	$41.00
February	100.00	38.00	65.00	41.00
March	100.00	38.00	65.00	41.00
April	100.00	38.00	61.00	43.50
May	100.00	38.00	61.00	47.50
June	105.00	37.50	61.00	48.00
July	103.00	37.50	58.50	49.50
August	105.00	100.00	56.00	52.00
September	110.00	80.00	55.00	55.00
October	105.00	66.00	50.00	59.00
November	100.00	66.00	50.00	61.00
December	100.00	68.00	45.00	65.00

Because of the high prices and the difficulty to get ferro-manganese, many consumers adjusted their operations to use spiegeleisen. At the

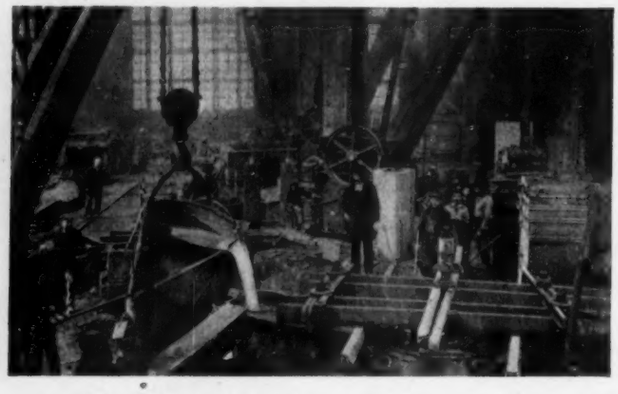
(*Continued on Page 56.*)

France's War-Smith--Schneider of Creusot

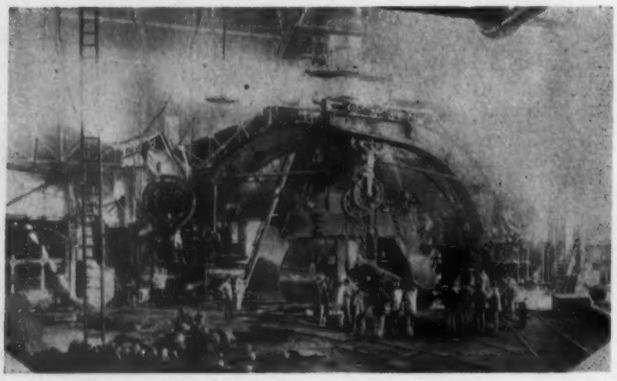
PANORAMIC VIEW OF WORKS OF M. M. SCHNEIDER & CO., LE CREUSOT, FRANCE



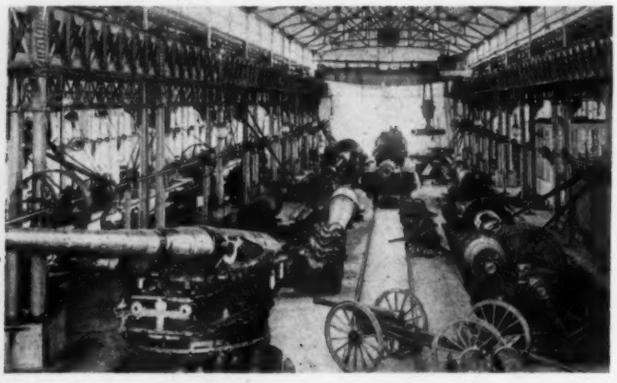
BLAST FURNACE GROUP, SCHNEIDER-CREUSOT WORKS



IRON FOUNDRY, SHOWING POURING METHODS

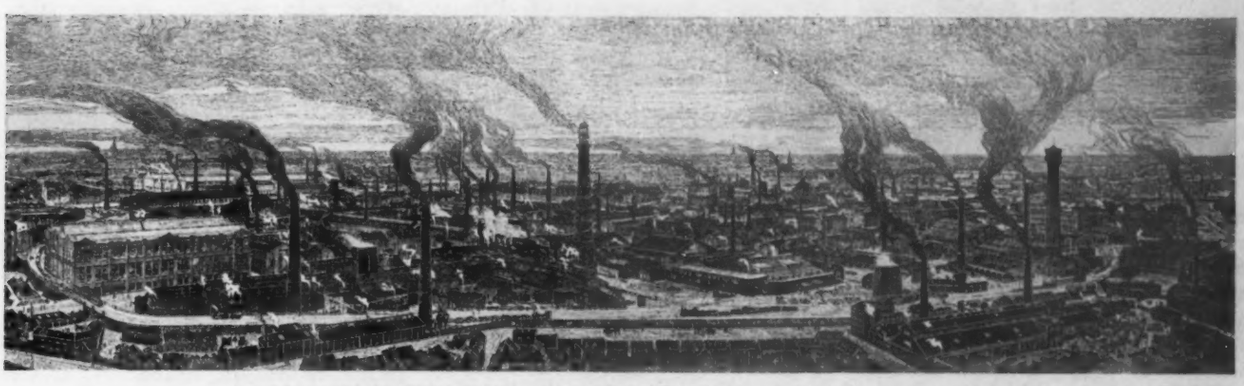


SCHNEIDER-CREUSOT 100-TON STEAM HAMMER

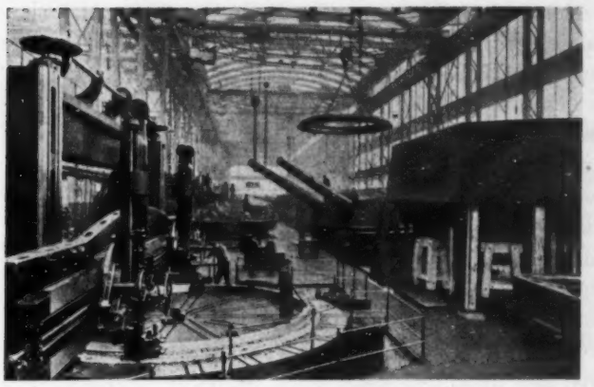


SCHNEIDER GUN ERECTING SHOP

Krupp Works--Germany's First Armorer

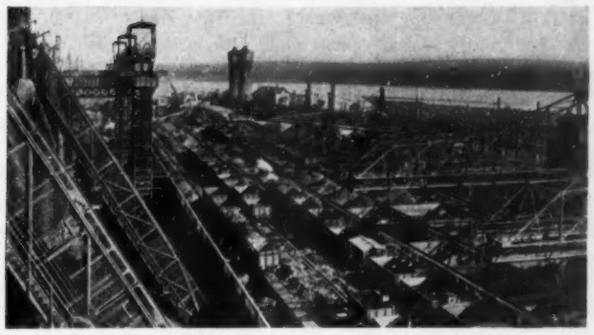


GENERAL PANORAMA OF THE MAIN KRUPP WORKS, ESSEN-ON-THE-RUHR

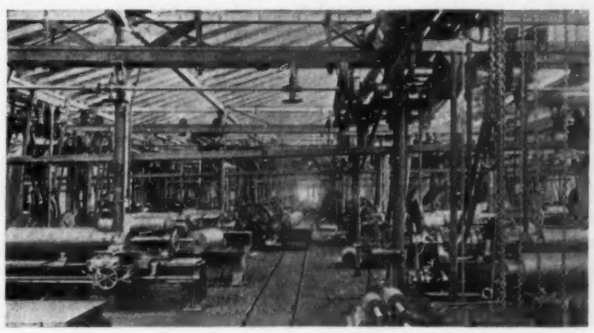


WORKSHOP NO. 9, KRUPP ESSEN WORKS

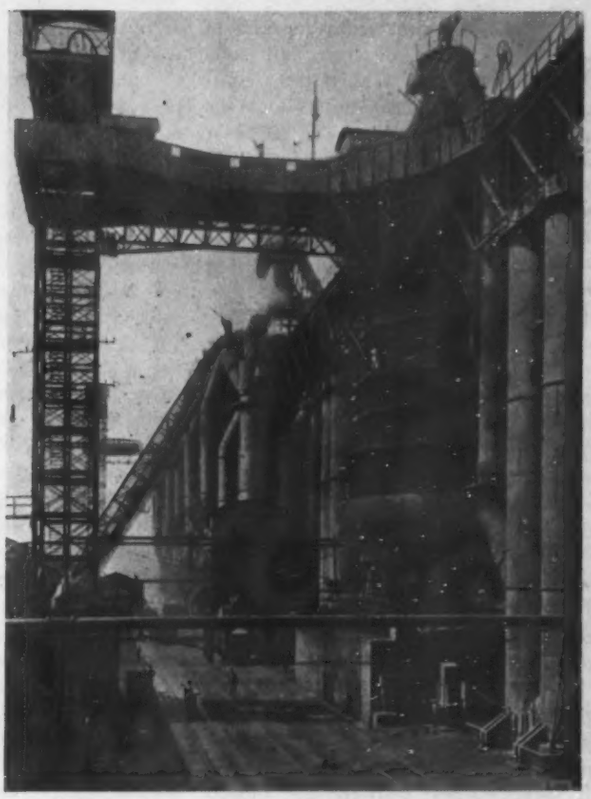
WORKMEN'S HOMES AT ESSEN



RAW MATERIAL STORES AT A KRUPP PLANT



ROLL TURNING SHOP, KRUPP GRUSON WORKS



BLAST FURNACES, FRIEDRICH-ALFRED HUETTE
KRUPP WORKS

Pittsburgh Makes Its Greatest Record

DURING the last half of 1915 the tremendous productive capacity of the great Pittsburgh district was overwhelmed by the combined demands of foreign and domestic producers. The finished material market was the first to feel the improvement which was later shared by pig iron. By-product coke is becoming a factor of importance in western Pennsylvania. The year closed with labor conditions satisfactory.

By C. F. Williams

NEVER before in the annals of the iron industry of the United States was such remarkable recuperative ability displayed as that shown by the market in 1915. Foundations for a prolonged era of prosperity, commensurate with the period of depression through which the country recently passed, were laid during the first half of the year, and the progress made during the last six months of 1915 exceeded the expectations of the most sanguine leaders of the industry. All previous production records were shattered by blast furnaces and finishing mills, and prices advanced, almost by leaps and bounds, from abnormally low to unprecedentedly high levels. Prospects for the future never were brighter than at present.

Timidity and hesitancy, engendered by the stupendous war in Europe, were replaced eight months ago by confidence in the future. Domestic consumers of semi-finished and finished steel products, who refused to buy except for immediate requirements during 1914 and the early part of 1915, literally besieged mill managers with orders for future shipment during May, June and July. Despite subsequent sharp advances in prices, buying showed no diminution the latter part of the year.

At the expense of the unfortun te warring nations, American manufacturers have played an important part in the markets of the world in the last 10 months, and every possible effort is being made through individual enterprise and through such organizations as the American International Corporation, to deal adequately with the export situation. Much depends, of course, upon the establishment of a merchant marine, and the adoption of a tariff to protect our industries after the war ceases. The war not only opened the gates of world-wide commerce to America, but provided a tariff wall that has permitted the United States to develop its industries along broader lines.

DURING the first eight months of 1915, exports of iron and steel commodities were $212,700,000, compared with $140,200,000 in 1914. Our balance of trade for the year just ended is expected to exceed $1,800,000,000, or about three times as much as we enjoy under normal conditions.

The war devastating Europe was responsible for a considerable portion of the activity enjoyed by the iron trade in 1915. Exports of pig iron, semi-finished and finished steel products and machinery to entente nations involved tremendous expenditures. And sales of steel for the manufacture of munitions and other war material in this country also were heavy. Before the close of the year, however, many manufacturers were refusing to book additional orders for export, because of their desire to take care of domestic consumers' requirements, which rapidly grew in volume the latter part of 1915.

The pig iron market, like that for other products not directly affected by the war, did not become active until after the close of the first half of 1915. Prices showed no important changes in position the first and second quarters, although it was apparent quotations would advance sharply just as soon as the long-expected buying movement got under way. This movement was inaugurated the second week of July, when Mahoning valley melters purchased about 75,000 tons of steelmaking grades. Pig iron prices, which responded quickly to the increased demand of consumers, gradually climbed toward higher levels the second half of the year, and "twenty-dollar" iron became a reality the last fortnight of 1915.

Ever Growing Production

During the first six months, monthly production of pig iron climbed from 1,591,024 tons to 2,369,932 tons. To meet the insistent demand of consumers during the third and fourth periods, it was necessary to blow in practically every serviceable blast furnace stack in the country. The Carnegie Steel Co., which was blowing 50 of its 59 blast furnaces in December, plans to apply the torch to two additional stacks at an early date; both of these furnaces have been idle many years. Production of pig iron the eleventh month of 1915, 3,035,235 tons, was at the rate of 36,900,000 tons a year.

Bessemer pig iron was quoted at $14.70, Pittsburgh, the first six weeks of the year just ended. The price declined about 25 cents a ton early in February, and lost ground was not regained until the latter part of July, when valley blast furnaces sold this grade at $14, furnace, or $14.95, Pittsburgh, the freight rate from the valleys to Pittsburgh being 95 cents a ton. Bessemer iron continued its march toward higher levels during August and September, selling at $16.95, Pittsburgh, at the close of September. No change in price was noted again until early in November, when sales were made at $17.95, Pittsburgh. Iron commanded $18, valley, early in December, and sales at $19, $19.50 and even $20, valley, were reported the last two weeks of the year. Bessemer iron advanced $5.20 a ton during 1915.

Basic pig iron was held at $13.45, Pittsburgh, until June 10, last, when it advanced to $13.60, and remained at that figure for more than a month. In August, this grade climbed to

$15.20, Pittsburgh; considerable tonnage was sold at $15.95, Pittsburgh, in September and October, and an advance of $1 a ton was made in November. The market was comparatively quiet in December, although some iron was sold at $18.95, Pittsburgh. In fact, basic iron for export commanded as high as $18.40, valley, or $19.35, Pittsburgh, the latter part of the year. Approximately 30,000 tons of steelmaking iron was sold for export to Italy, France and England last year. Basic iron registered an advance of $5.50 a ton during the year.

Foundry Iron Dips

No. 2 foundry iron declined from $13.70, Pittsburgh, to $13.45 during the first four months of the year and the $13.45 figure did not disappear until July, when the $13.70 price was re-established. Sales were made on the basis of $15.45, Pittsburgh, during August, September and October; in November, melters paid $16.95, Pittsburgh, and numerous small lots commanded $19.45, Pittsburgh, and slightly above, the last month of the year. The trend of the market for malleable iron was similar to that of No. 2 foundry. Both grades registered advances of $6 a ton.

Gray forge iron was quoted at $13.45, Pittsburgh, the first four months of 1915, and sold at $13.20, Pittsburgh, the ensuing three months. An advance of 50 cents a ton was made in August, and this grade commanded $19.45, Pittsburgh, and slightly higher the third quarter of the year. In December, sales at $18.45, Pittsburgh, were reported. Gray forge iron, at the close of 1915, commanded $5.25 a ton above the lowest figure recorded during the year.

Although steel works furnaces were driven at capacity the first six months of the year, and rather large tonnages of iron were accumulated, some of the more important steel manufacturers were driven into the open market for part of their pig iron requirements. The Youngstown Sheet & Tube Co. purchased not less than 150,000 tons of steelmaking grades the last half of 1915. The Jones & Laughlin Steel Co. bought 60,000 tons; the Republic Iron & Steel Co., about 50,000 tons; the American Rolling Mill Co., 20,000 tons; the Andrews Steel Co., 20,000 tons; the Allegheny Steel Co., 10,000 tons, and the West Penn Steel Co., 10,000 tons of steelmaking iron and second and third quarters of 1915. The National Malleable Castings Co., the American Steel Foundries, the Standard Sanitary Mfg. Co., the Westinghouse interests; the Marshall Foundry Co., Follansbee Bros., and several other melters took miscellaneous pig iron grades for fourth and first quarter shipment.

The Republic Iron & Steel Co. has completed plans for the addition of a 500-ton blast furnace to its Hazelton group, which will provide eight furnaces in the north and three in the south for the Republic company. The Youngstown Sheet & Tube Co. will add another 500-ton stack to its present group of four modern blast furnaces. The United Furnace Co., Canton, O., is building a 500-ton blast furnace. Several stacks have been remodeled or rebuilt in the Greater Pittsburgh district; the Jones & Laughlin Steel Co. is manufacturing ferro-manganese from foreign ores at the Rebecca furnace of the Kittanning Iron & Steel Co., Kittanning, Pa. The Sharpsville furnace of the Sharpsville Furnace Co., Sharpsville, Pa., was purchased by the Allen S. Davison Co., Pittsburgh, which controls the Bessie furnace at New Straitsville, O. A rather unusual accident occurred to the Alice furnace of the Valley Mold & Iron Co., Sharpsville, Pa., Dec. 11, when the stack virtually collapsed after a slip of the burden, taking the furnace from the active list at a time when pressure for iron was heavy.

Semi-Finished Steel Soars

With rolling mills producing finished products at the rate of almost 28,000,000 tons a year, demand for semi-finished material exceeded all expectations during the last six months of 1915. The Carnegie Steel Co., the Jones & Laughlin Steel Co., the Cambria Steel Co., the Youngstown Sheet & Tube Co. and the Brier Hill Steel Co. were forced to withdraw from the market as sellers of billets and sheet bars, and some consumers, who had not sufficiently covered requirements, were unable to obtain desired tonnages in the open market. Billets advanced $11.50 a ton, and sheet bars $13 a ton during the 12-month period just ended.

Bessemer and open hearth steel billets were quoted at $19.50, maker's mill, the first six months of 1915, and both grades of sheet bars were listed at $20.50, mill, until after July 1. Consistent advances were registered by billets and sheet bars after the opening of the second half of the year; billets commanded $31 and sheet bars $32 a ton in December. Forging billets were sold at $55 and above during the fourth quarter. Wire rods, which were decidedly scarce, nominally were quoted at $40, Pittsburgh, at the end of the year. Open hearth steel products were relatively stronger than bessemer material until Novem-

Average Monthly Prices at Pittsburgh in 1915

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Bessemer	$14.70	$14.63	$14.55	$14.55	$14.55	$14.58	$14.88	$15.89	$16.80	$16.95	$17.45	$19.70
Basic	13.45	13.45	13.45	13.45	13.45	13.54	13.83	14.89	15.65	15.95	16.70	18.55
Foundry	13.70	13.95	13.80	13.45	13.45	13.45	13.60	14.70	15.45	15.57	16.45	18.85
Malleable	13.70	13.70	13.80	13.45	13.45	13.45	13.60	14.70	15.45	15.57	16.45	18.85
Gray forge	13.45	13.45	13.45	13.40	13.20	13.20	13.20	14.20	14.95	15.07	15.88	18.15
Ferro, Baltimore	68.00	68.00	90.00	90.00	88.00	95.00	98.00	97.00	109.00	108.00	99.00	100.00
Ferro-silicon	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00	79.00	83.75	83.00
Bess. billets	19.50	19.50	19.50	19.50	19.50	19.87	21.40	23.00	24.60	25.50	27.75	29.60
Open hearth billets	19.50	19.50	19.50	19.50	19.50	19.87	21.50	24.00	25.60	26.50	28.00	30.20
Bessemer sheet bars	20.00	20.00	20.00	19.60	19.50	20.37	21.70	24.00	24.60	25.50	28.25	30.80
Open hearth sheet bars	20.00	20.00	20.00	19.60	20.00	20.37	22.00	25.00	25.80	26.50	28.50	30.80
Steel rails	1.25c	1.25c	1.25c	1.25c	1.25c	1.25c	1.25c	1.25c	1.25c	1.25c	1.25c	1.25c
Beams	1.10c	1.10c	1.15c	1.15c	1.20c	1.20c	1.25c	1.30c	1.34c	1.41c	1.625c	1.74c
Plates	1.10c	1.10c	1.125c	1.11c	1.125c	1.15c	1.22c	1.30c	1.32c	1.42c	1.625c	1.74c
Steel bars	1.10c	1.10c	1.15c	1.20c	1.20c	1.20c	1.26c	1.30c	1.34c	1.41c	1.625c	1.74c
Iron bars	1.12c	1.10c	1.10c	1.20c	1.20c	1.24c	1.25c	1.30c	1.37c	1.47c	1.60c	1.84c
Tin plate	$3.10	$3.10	$3.10	$3.20	$3.18	$3.10	$3.10	$3.10	$3.10	$3.10	$3.35	$3.60
No. 28 black sheets	1.80c	1.80c	1.80c	1.80c	1.80c	1.80c	1.77c	1.83c	1.92c	2.05c	2.22c	2.50c
No. 28 galvanized sheets	2.77c	3.01c	3.40c	3.30c	3.40c	4.46c	4.55c	3.93c	3.67c	3.50c	3.90c	4.75c
No. 10 blue sheets	1.30c	1.30c	1.30c	1.30c	1.35c	1.35c	1.35c	1.36c	1.52c	1.60c	1.85c	2.25c
Wire rods	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.60	$26.75	$28.50	$30.00	$34.50	$39.00
Wire nails	1.51	1.55	1.60	1.59	1.55	1.55	1.59	1.61	1.69	1.76	1.87	1.98
Plain wire	1.31	1.35	1.40	1.39	1.35	1.35	1.39	1.42	1.54	1.62	1.72	1.83
Hoops	1.25c	1.25c	1.25c	1.25c	1.25c	1.25c	1.26c	1.32c	1.42c	1.52c	1.75c	1.94c
Heavy melting	$11.55	$11.62	$12.00	$11.90	$11.75	$11.75	$11.75	$13.38	$14.25	$14.00	$15.31	$17.40
Structural rivets	1.45c	1.45c	1.45c	1.45c	1.45c	1.49c	1.50c	1.50c	1.61c	1.75c	2.28c	2.46c

ber, when the differential in price disappeared.

How much of the billet tonnage rolled last year was used for the manufacture of war material, is difficult to estimate, but manufacturers of sheets and munitions played an important part in the billet market. The Corporation purchased heavy tonnages of billets in the east, and considerable semi-finished tonnage was shipped to Pittsburgh from the Chicago district in the third quarter. The Brier Hill Steel Co. in August took an order for 50,000 tons of blooms for shipment to France. Representatives of belligerent nations contracted for as much material as mills would offer, but details of such transactions generally were withheld.

Plates, Shapes and Bars

Mills rolling plates, shapes and bars closed the year of 1915 with enough tonnage on their books to keep plants operating at maximum capacity for from six to nine months. While buying of steel plates and structural material was not relatively so heavy as that of steel bars, yet mill managers had no cause to complain. Practically all the structural tonnage entered the last four months of the year was for specific work, and indications are that demand will increase in volume the early part of 1916. Specifications for larger sizes of steel rounds, for the manufacture of shrapnel shells, involved tremendous tonnages during the last eight months of 1915. Some plants were forced to divert considerable shrapnel tonnage to rail mills in order to meet specifications for delivery.

Fabricators were hungry for tonnage until after July 1. As a consequence, extremely low prices were offered during the first six months of the year. Car buying was more active in 1915 than in the year previous, but was below normal. According to unofficial records, approximately 62,000 steel cars were purchased in the first half of the year just ended, and about 61,000 cars were ordered during the first five months of the second half.

Plates, shapes and steel bars sold at 1.10c and 1.15c during the first quarter. Buying for the second half of the year started in June, on a 1.25c level, or $3 a ton above the price at which most consumers covered first half requirements. Prices climbed toward higher levels in August, September and October. In November, prices jumped from 1.50c to 1.70c, or $4 a ton. Material was offered at 1.70c, for shipment at the convenience of the mill, until Dec. 15, when the Carnegie Steel Co., the Jones & Laughlin Steel Co. and other important makers advanced prices $2 a ton to a 1.80c basis. Material was sold at 2c and above by mills in a position to accept specifications for prompt shipment. Generally, most mills declined to book orders for additional tonnages after Dec. 1 except for specific work.

Bar iron reflected strength similar to that displayed by steel bars. Iron bars sold at 1.15c, at the opening of the year; they advanced $4 a ton during the first half. At the close of the year, this product was quoted at 1.90c, or $15 a ton above the price prevailing 12 months previous. Steel plates, shapes and bars, for future delivery, advanced $14 a ton in 1915.

Prompt Connellsville Coke Prices

	Furnace					Foundry				
	1911.	1912.	1913.	1914.	1915.	1911.	1912.	1913.	1914.	1915.
January	$1.41	$1.84	$3.88	$1.79	$1.59	$1.97	$2.05	$4.45	$2.48	$2.00
February	1.44	1.85	2.56	1.82	1.55	1.95	2.22	3.69	2.40	2.00
March	1.58	2.06	2.41	1.94	1.51	2.00	2.65	3.50	2.40	2.00
April	1.55	2.44	2.25	1.90	1.53	1.99	2.75	3.06	2.40	2.00
May	1.44	2.57	2.00	1.77	1.55	1.90	2.62	2.89	2.40	2.00
June	1.40	2.17	2.04	1.75	1.55	1.77	2.56	2.85	2.35	2.00
July	1.42	2.25	2.50	1.75	1.67	1.80	2.46	2.85	2.29	2.00
August	1.51	2.25	2.50	1.75	1.61	1.85	2.60	2.85	2.25	2.07
September	1.50	2.31	2.31	1.67	1.66	1.85	2.67	2.85	2.25	2.27
October	1.50	3.22	2.07	1.65	2.00	1.86	3.35	2.76	2.21	2.37
November	1.50	3.82	1.84	1.60	2.50	1.89	4.41	2.50	2.10	2.96
December	1.64	3.93	1.75	1.60	2.67	1.90	4.50	2.50	2.00	3.17
Average	1.48	2.55	2.34	1.75	1.78	1.89	2.90	3.06	2.29	2.24

High Spelter Curbs Sheet Sales

Manufacturers of steel sheets experienced quiet conditions the first six months of 1915. Prices of black and blue annealed sheets were low until after the opening of the second half. Galvanized sheet products fluctuated in price during the entire year, on account of irregularity in the price of spelter. Spelter was listed at 5.45c, East St. Louis, on Jan. 1, 1915; at 8.75c on Apr. 1; at 22c on July 1 and at 17.50c on Dec. 16. The almost prohibitive price of this metal made it impossible for many manufacturers of galvanized ware to figure in the market, and at no time during the year were galvanizing departments operating at much above 50 per cent of capacity.

Galvanized steel sheets sold at a wide range of price. Material was offered at as low as 2.75c for No. 28 gage the early part of the year, and some tonnage commanded as high as 5.25c for No. 28 gage. Black steel sheets advanced $15 a ton, from 1.75c to 2.50c for No. 28 gage, and blue annealed products advanced $19 a ton, from 1.30c to 2.25c for No. 10 gage. Mills were beset with numerous difficulties the greater part of the year. Sheet bars were scarce and deliveries were uncertain; the skyrocketing performance of spelter reduced demand and curtailed production of galvanized products, and a shortage of sulphuric acid handicapped a number of manufacturers. Prospects for a record-breaking year are bright; mills have heavy back-log tonnages on their order books, and the bulk of the tonnage sold at low prices has been rolled.

Tin Plate in War Times

The market for the shipment of tin plate during the 1916 season formally was opened Nov. 11, when the American Sheet & Tin Plate Co. announced a price of $3.60, per 100-pound cokes, f. o. b., Pittsburgh. Pig tin on that date was quoted at a range from 38c to 39c, and sheet bars were quoted at an average of about $27.50, mill. The situation for both pig tin and sheet bars for future delivery was uncertain; the European war might shut off shipments of tin, and sheet bars were scarce and deliveries uncertain. These conditions combined to strengthen the tin plate market, and the $3.60 price was well maintained, although larger can manufacturers were able to cover needs at $3.50.

Tin plate makers opened books for shipment during the 1915 season on Dec. 3, 1914, at $3.20, base, but that figure was shaded $3 and $4 a ton by all mills. Pig tin was quoted at 33.50c and sheet bars at $19.50 on the announcement date. The price of all commodities entering into the manufacture of tin plate, including steel, pig tin, palm oil and sulphuric acid, advanced considerably during the year. In accordance with the British tin regulations, tin plate contracts made since last November carry a clause limiting the destination of the tin plate and the containers made from it, to prevent material reaching nations hostile to Great Britain.

Provision for increasing the tin plate capacity of several mills in the Greater Pittsburgh district was made during 1915. The Standard Tin Plate Co., Cannonsburg, Pa., will complete

10 new mills early in January; the McKeesport Tin Plate Co., McKeesport, Pa., is building 20 new mills, which will provide a total of 42; the Phillips Sheet & Tin Plate Co., now operating 44 mills, is installing 4 additional mills at its Weirton, W. Va., plant, and the Wheeling Steel & Iron Co. is adding six mills to its 12 mill plant at Yorkville, O.

A wave of unprecedented prosperity swept over the market for wire products in 1915. Pittsburgh manufacturers were forced to withdraw from the market as active sellers three or four months before the close of the year. Accumulated specifications on Dec. 31 involved sufficient tonnage to keep mills in western Pennsylvania and eastern Ohio engaged at maximum capacities for seven months or more. Much of the prosperity enjoyed by manufacturers of wire products may be attributed to the European war. Practically every mill in the country sold heavy tonnages to the entente nations, at prices slightly above the domestic market.

1915 Coke Prices

MONTHLY MINIMUM PRICES CONNELLSVILLE FURNACE AND FOUNDRY COKE PER TON AT THE OVENS IN 1915.

	—Furnace—		—Foundry—	
Months.	Prompt.	Contract.	Prompt.	Contract.
Jan.	$1.59	$1.69	$2.00	$2.25
Feb.	1.55	1.65	2.00	2.25
Mar.	1.51	1.65	2.00	2.25
Apr.	1.53	1.65	2.00	2.25
May	1.55	1.65	2.00	2.25
June	1.55	1.65	2.00	2.25
July	1.67	1.67	2.00	2.25
Aug.	1.61	1.75	2.07	2.25
Sept.	1.66	1.84	2.27	2.37
Oct.	2.00	2.25	2.37	2.48
Nov.	2.50	2.35	2.96	2.96
Dec.	2.67	2.35	3.17	3.00
Aver. for year	1.78	1.85	2.24	2.40

Wire products in 1915 commanded the highest prices recorded in seven years. On Jan. 1, last, wire nails were quoted at $1.50 a keg. On Dec. 1, the price of nails was $2 a keg, or $10 a ton above the price offered 11 months previous. A reduction of 5 cents per 100 pounds in the differential between nails and plain wire, caused plain wire to advance $11 a ton during the first 11 months. The following outline of prices and price changes shows how wire nails in carloads to jobbers, moved upward in 1915:

	A keg.
Jan. 1	$1.50
Jan. 11	1.55
Feb. 10	1.60
Aug. 23	1.65
Sept. 20	1.75
Oct. 21	1.85
Nov. 12	1.90
Dec. 1	2.00

On July 6, galvanized products were advanced to meet higher prices of spelter, but the extra for galvanizing was reduced from 80 cents to 60 cents per 100 pounds on Aug. 23. On Aug. 30, it was advanced to 70 cents per 100 pounds; the 70-cent differential continued to prevail the remainder of the year.

Tubular goods manufacturers did not benefit directly in 1915 from the war raging in Europe. Mills in the Greater Pittsburgh district did not operate at much above 75 per cent of capacity at any time during the year. However, the outlook at the close of 1915 was regarded as satisfactory. A number of large undertakings in the oil and gas fields are now under active consideration and indications are that the market for oil country goods will be decidedly active the next few months.

Steel pipe manufacturers advanced black pipe, up to 6 inches in diameter, $2 a ton on Feb. 11; galvanized steel pipe was put up from $2 to $6 a ton on that date to meet higher prices of spelter. All sizes were advanced $2 a ton, May 1. On June 1, galvanized steel pipe was put up $12 a ton, and a $10-a-ton advance was made 17 days later to meet the abnormally high price of spelter, which was selling at about 20 cents a pound at that time. On Aug. 16, when spelter was quoted at 16 cents a pound, galvanized steel pipe was reduced $12 a ton. Black steel pipe was advanced $2 a ton, Nov. 1, last. Three-fourths inch to 3-inch black steel pipe advanced $4 a ton and galvanized steel pipe of the same sizes advanced $12 a ton during the year. Iron pipe manufacturers followed all the changes in prices made by mills rolling steel pipe.

Steel boiler tubes, the last seven months of 1915, advanced $15 a ton. Seamless tubing, demand for which was decidedly heavy during the entire year, commanded the highest prices reached in many years. The Shelby Steel Tube Co. completed plans for doubling the capacity of its seamless tube mill at Ellwood City, Pa. The Jones & Laughlin Steel Co. is building two butt-weld and two lap-weld furnaces at Aliquippa, Pa.

Old Material

Old material, like pig iron, bordered on a state of lethargy the greater part of the first half of 1915. Heavy melting steel sold at a range from $11.50 to $11.75 the first and second quarters of the year, and other grades were quoted at correspondingly low prices. Demand, however, became unusually heavy shortly after the opening of the second half, and heavy melting steel jumped to $14, delivered, in August. Some material commanded $14.75 the latter part of that month. An unexpected decline occurred in October, when heavy melting steel scrap dropped to $14, at which price rather heavy tonnages were sold for future shipment.

Dealers advanced prices sharply the latter part of October, and heavy melting steel was established at $16 the following month. In December, melters paid more for this grade than for basic pig iron, a rather unusual circumstance. Before the end of the year, some tonnage was sold on the basis of $18.50, delivered, and dealers felt confident that $20 scrap would be sold before the end of January. Low phosphorus steel scrap commanded as high as $21; No. 1 wrought scrap sold at $17, and other grades climbed to almost unprecedented levels during November and December.

The market for Connellsville coke, contrary to expectations, failed to show any recuperative ability in 1915. Blast furnace fuel last year sold at approximately the same prices prevailing in 1914, which were regarded as low and unattractive. The average price of 48-hour coke for prompt shipment in 1914 was $1.75; in 1915, it was $1.78 a ton at the ovens. The "slump" of 1914 was attributed to the general business depression; the failure of the Connellsville market to reflect improvement in 1915 was caused to a considerable extent by the increase in the production of by-product oven coke. The financial difficulties of J. V. Thompson, former banker and coal land owner of Uniontown, Pa., were brought on by the growth and development of the by-product coke oven industry, according to several of Mr. Thompson's friends.

Bar Iron Prices

BI-MONTHLY SETTLEMENTS SHOWING AVERAGE PRICES OF BAR IRON

	1912.	1913.	1914.	1915.
Jan.-Feb.	1.187c	1.4831c	1.1590c	1.024c
Mch.-Apr.	1.195c	1.5434c	1.1760c	1.05c
May-June	1.2183c	1.5272c	1.1257c	1.10c
July-Aug.	1.2518c	1.5029c	1.0928c	1.15c
Sept.-Oct.	1.3351c	1.3931c	1.0847c	1.20c
Nov.-Dec.	1.40c	1.2030c	1.037c	....

ANNUAL AVERAGE OF SETTLEMENTS

1914	1.1125c
1913	1.4421c
1912	1.2645c
1911	1.2598c
1910	1.4423c
1909	1.360c
1908	1.386c
1907	1.627c
1906	1.587c

Contracts for more than 1,100 by-product coke ovens were awarded by producers of pig iron in 1915. These contracts included 204 ovens for the Youngstown Sheet & Tube Co.; 75 for the Republic Iron & Steel Co.; 204 for Corrigan, McKinney & Co.; 92 for the Cambria Steel Co.; 47 for

(*Continued on page 52.*)

West Felt Improvement Slowly

THE TIDE of prosperity which, attendant on the European upheaval, swept over the industrial United States, came from the east, and as a consequence, was not felt in the big iron and steel centers of the west until many months after it reached the Atlantic coast. At the present time, however, the situation has experienced a complete reversal from the stagnation prevailing everywhere only a brief year ago.

By George H. Manlove

ALTHOUGH its opening weeks were marked by a continuation of the disheartening conditions that prevailed at the close of the preceding year, conditions that seemed to present few rays of hope for better business,—1915 ended its career with a complete reversal.

The closing weeks saw steel mills running at capacity to make deliveries, prices almost doubled on many products, every blast furnace which could be operated turning out pig iron, output of furnace and mill sold for the first half of next year and buyers not protected by contract unable to buy steel or iron or compelled to pay a heavy premium for reasonable delivery. In every feature, the market has undergone a complete about face. Progress from the nadir to the zenith has been rapid, perhaps the fastest recovery ever seen in the history of iron and steel. With prices the lowest in two years, little interest on the part of consumers, plants operating at low mark, blast furnaces idle and little promise of better things, the iron and steel world opened the year wondering how it would be able to continue. With 1913 a dull period and the first half of 1914 duplicating previous conditions, a revival of home demand was just getting under way when the European war caused a pause of uncertainty and then started a decline that continued until the opening of 1915.

Products drooped until the cost level was met and passed and still buying was small. Consumers could see no reason for taking on stocks without prospect of using them, even though prices were most tempting. The trade seemed to be in a state of liquidation and stocks were used down to the lowest possible point.

EARLY in 1915, when European nations had taken account of stock and found they could not carry on their warfare without aid from America, demand began to appear for heavy tonnages of steel for shrapnel and for machinery to turn the steel into munitions. This demand appeared first in the east, as close to tidewater as possible to expedite delivery and to save freight charges. As early as February prices on finished steel began to strengthen in the east and the new levels were reflected in the west, although the demand on western producers did not appear until some months later, when producers in the east had no more to offer and domestic users awakened to their needs.

Progress of the wave of revivification from the center about New York proceeded in radiations like those from a pebble thrown into a stagnant pond. As producers in the east filled up with export business, domestic buyers found it increasingly difficult to obtain material and sought accommodation further west. Export business destined for shipment via Pacific ports was also placed in the Chicago district as an economical measure.

Western steel producers sat long watching the renewed prosperity of eastern mills, but the wave finally reached Chicago and engulfed it as it had done in the east and the entire productive capacity of the country was swallowed up in demand for all classes of steel and iron products.

An interesting feature of the growth of business is found in the slowness with which domestic demand awakened. While European buyers were pouring orders into the hungry mouths of steel mills, domestic demand lagged for months and when it finally awakened and gained force and volume it found the remaining tonnage possible to reserve was far too small for its needs.

While steel prices began to advance in February and maintained a steady gain throughout the year, pig iron and bar iron, two products which probably represent domestic demand more truly, did not feel the impetus until past the middle of the year. The United States was not buying. Suddenly the demand came and has continued with increasing volume, and now all products alike are in demand to a far greater extent than the producing capacity of the country can furnish them.

With actual business booked to the middle of 1916 and demand coming insistently for material throughout all of that year, steel makers are building additional capacity to meet the demand. Prosperity seems to be on a firm basis and a great forward step is being taken to meet the needs of steel users.

The United States Steel Corporation is adding almost 25 per cent to the ingot capacity of the great works at Gary, Ind., and also increasing capacity at the older plant at South Chicago. The American Sheet & Tin Plate Co. is erecting a large tin plate plant at Gary. The Inland Steel Co. is erecting open hearths to increase its output at least 50 per cent and the new plant of the Minnesota Steel Co. at Duluth, a subsidiary of the Steel Corporation, has been put into active service.

From the exigencies of its situation geographically, so far from tidewater, the Chicago district was last to feel the impetus of business and probably will be the last to catch its recession when conditions change, as so small a proportion of business booked here is for export. The year closes with not the slightest sign of falling off and the steel world rolls into 1916 with every expectation that even better things are in store. Optimism, a much misused term, is too weak to describe the attitude of steel makers toward the future. It indicates only hope, but hope is backed by real demand and

with the heavy actual specified tonnages on the books, the fruition cannot be doubted.

Slight indications at the opening of the year that something better might be in store for pig iron makers took long to develop, but the end of the year finds all stacks busy and prices about $5 per ton higher than in January. Only three of twelve merchant stacks were in blast at the opening of the year, but in the initial month another was blown in. Northern No. 2 foundry and malleable iron were quoted at $13, Chicago furnace, until early in August, when the first break upward was noted, when buying took a real start. The increase was tentative and made with caution, but was maintained and by the end of August the price had risen practically to $14, Chicago furnace.

Demand continued to an extent that prices advanced strongly toward the close of the year. November was the most active month, and in that period foundry and malleable advanced practically 50 cents per week, from a basis of $15.50 to $18 per ton, furnace.

The first indication of better things came when makers began in February to insist more closely on premiums for silicon, refusing to give more of this element than analysis calls for and asking premium for any increase. In the latter part of February, inquiry for last half iron began to appear and by the end of March the situation had crystallized sufficiently to bring out a quotation of $13.50, furnace, for that delivery. April sales were three to five times those of March, but prices did not react, stocks at furnace and idle capacity being too great a depressing influence.

June saw most melters covered for last half, but tonnages were below normal, contracts being on the basis of expectations, which were not sanguine. In July, malleable users began to busy themselves and took considerable tonnage. About this time inquiry for first half started and the market was started on the long climb to its present position. Prices, however, remained steady and not until the first of August did an increase register.

Only Two Idle

At the close, every steel works stack in this district is being run to its capacity and all merchant stacks except two are in blast. These two are idle for lack of ore, but probably will be started early next year, as there is demand for iron.

Announcement of iron ore prices for 1916, advanced 75 cents per ton over those prevailing during 1915, brings an increased cost of manufacturing pig iron of $1.50 per ton. Local furnace men paused at this announcement to take account of stock, but finally decided not to make an increase in quotation, believing the increased cost of ore had been largely discounted.

Lake Superior charcoal iron advanced more strongly than coke iron and a peculiar combination of circumstances made it possible for charcoal iron makers to dispose of large surplus stocks, which have been a load on the market for several years. During the first four months, charcoal iron remained at a level quotation of $15.75, delivered, Chicago, as a minimum and after a drop of 50 cents which continued during May and June, the former quotation was regained and in September it was possible to follow this with continuous advances to the end of the year, a maximum quotation of $22.25, delivered, Chicago, being made during December by one interest which had little to sell while other sellers were willing to quote $19.25 to $20.25 for the entire range.

Stacks are practically sold up for the entire first half and some demand is being felt for contracts through the year. The outlook is for higher prices and larger sales than the present year, as foundries have booked larger business and see no falling off in any direction.

Steel makers have found the year more than satisfactory. Beginning with slack business all over the country, the year ends with order books crammed to the ability of mills to turn out tonnage, many inquiries refused flatly and output sold well past the middle of next year. Bars, shapes and plates started the year at 1.29c, Chicago mill, and at the close are quoted nominally at 1.99c, Chicago, and increase of 0.70c for the year. This price does not represent the actual gain, however, as the nominal quotation is far below prices being paid for steel for any sort of prompt delivery, premiums bringing cost to 2.29c to 2.69c, Chicago.

The first gain came in April when 1.39c, Chicago, was quoted. In June, the leading interest quoted 1.49c, Chicago mill, led thereto by heavy business of the eastern subsidiaries. Independents who had not participated in the eastern business and were hungry for tonnage did not follow this raise for several weeks. In fact, western independents lagged in price for some time, gradually filling their books and finally attaining a sold-up condition equal to eastern makers.

It developed about the middle of August that all mills were well sold for the remainder of the year and all prices were on a basis of 1.54c, Chicago. By the first of September, inquiries for the remainder of the year were turned down and in October demand for first half bookings became insistent. By the middle of the month, first quarter output was covered and by Nov. 1 little remained for first half delivery. The nominal quotation then was 1.69c, Chicago, which was increased to 1.79c, Chicago, early in November and to 1.89c, by the opening of December, with large premiums for prompt delivery on the part of makers who could offer such.

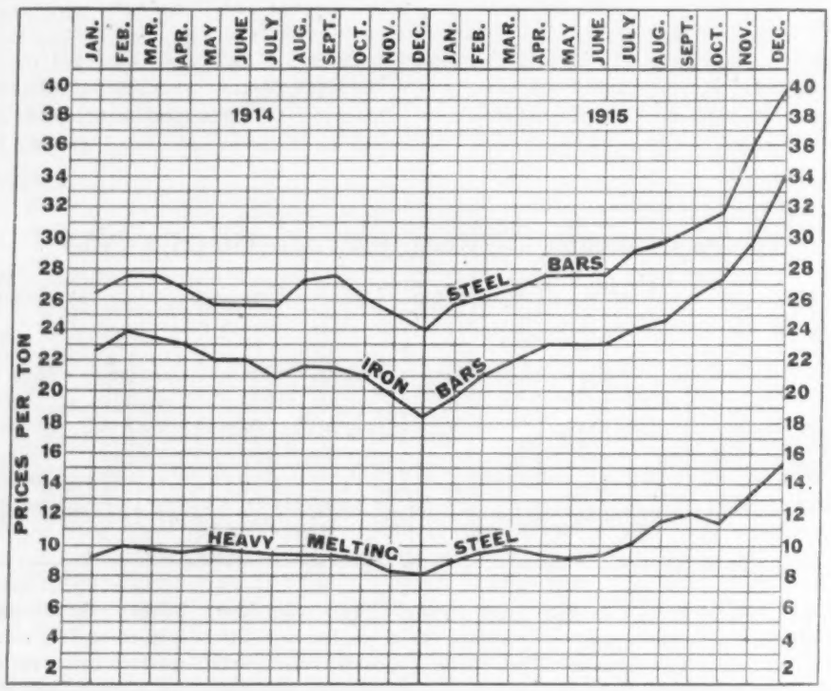
Plates lagged at about $1 per ton below bars and shapes, but late in

Average Monthly Prices, Chicago District 1915

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Lake Superior charcoal pig iron	$15.75	$15.75	$15.75	$15.75	$15.25	$15.25	$15.75	$15.75	$15.95	$16.25	$17.50	$19.25
Northern No. 2 foundry pig iron	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.38	13.80	14.44	17.12	18.00
Southern No. 2 foundry pig iron	13.75	13.69	13.50	13.50	13.50	13.50	13.50	14.00	14.50	15.50	16.88	18.00
Bar iron f. o. b. mill	.98	1.045	1.10	1.15	1.15	1.15	1.20	1.23	1.31	1.37	1.48	1.70
Steel bars f. o. b. mill	1.29	1.31	1.34	1.38	1.39	1.39	1.46	1.49	1.54	1.59	1.79	1.89
Structurals	1.29	1.31	1.34	1.36	1.34	1.39	1.46	1.49	1.54	1.59	1.79	1.89
Plates	1.28	1.27	1.34	1.28	1.29	1.31	1.39	1.44	1.49	1.55	1.79	1.89
Sheets No. 28 black, f. o. b. mill	1.99	1.96	1.94	1.94	1.90	1.89	1.91	2.01	2.10	2.21	2.43	2.69
Plain wire, jobbers' carloads	1.54	1.54	1.54	1.54	1.54	1.54	1.57	1.64	1.75	1.81	1.92	2.00
Wire nails, jobbers' carloads	1.74	1.74	1.74	1.74	1.74	1.74	1.77	1.81	1.88	1.96	2.07	2.15
No. 1 R. R. wrought, net ton	8.81	8.88	9.00	8.55	8.75	8.75	8.90	10.12	10.75	10.68	12.75	14.90
Heavy melting steel, gross ton	8.87	9.44	9.75	9.30	9.25	9.37	10.15	11.50	12.00	11.56	13.13	15.30
Rerolling rails, gross ton	9.50	9.62	10.00	9.85	10.00	10.00	10.10	11.75	13.15	13.25	14.31	15.80
Malleable	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.38	14.20	15.12	17.42	18.00
Car wheels	10.00	10.00	10.00	10.00	9.75	9.87	10.30	11.38	11.75	11.75	12.73	14.75

the year demands for ship and car building changed the situation and at the close of the year plates were demanding larger premiums than other products.

Bar iron participated in the good things brought by 1915 and practically doubled its price during that period. At the opening of the year, bar iron was quoted at 0.975c, but sympathetically felt the upturn in the steel market and advanced by easy stages on comparatively small demand until 1.15c was quoted in June, 1.25c in August, 1.35c in September, 1.45c in October, 1.60c in November and 1.75c in December. Perhaps the most marked buying movement came about in September, when quotations were advanced from 1.35c to 1.45c, mills which formerly were running hand to mouth then accumulating a backlog which almost insured operation to the end of the year. As steel bar deliveries became further deferred, extra demand was put on iron bars and this aided greatly in strengthening this commodity. Bar iron makers have been chary of contracting far in advance and up to the middle of December practically no tonnage had been booked for delivery beyond February. Some contracts had been allowed to lap a short distance into 1916, but for the most part were confined to immediate specification and delivery.



PRICES OF BARS AND HEAVY MELTING STEEL AT CHICAGO IN 1914 AND 1915

Sheets Make History

The sheet market during 1915 made history. The most sympathetic happening was in the galvanized sheet market, which is dependent in large degree on the price of spelter. When the latter metal became hysterical and advanced to levels never before known, the production of galvanized sheets became almost impossible. Actual cost of producing galvanized sheets went far beyond the figure at which ordinary consumers could use them profitably and wide fluctuations in the cost of spelter made it difficult for galvanizers to quote in a way to protect themselves from possible loss. The unprecedented prices quoted on zinc held a continual threat of collapse and prevented galvanizers from providing a sufficient stock to cover their contracts, in the fear the price might decline quickly. The leading independent maker of sheets in Chicago retired from this branch of its manufacture early in the year and consistently refused to book any orders. Prices ranged irregularly and at the close of the year, as high as 5.25c, Chicago, was being paid.

Black and blue annealed sheets pursued an uneventful course with slack demand during September. In November, quotations were moved up, not so much on account of demand for sheets as from the necessity of obtaining higher prices because of the higher value of sheet bars. Black sheets No. 28 gage sold as high as 2.94c, delivered, Chicago, late in the year.

Scrap Market

The scrap market practically doubled its prices in the twelve months. Heavy melting steel was obtainable in January at $8.50 and in December it was sold at $16. Scrap, as usual, felt the impetus toward higher levels in advance of other commodities and a steady rise was registered through the year, the last three months seeing an unusually active demand and strong advances. Prices reached a level which tempted country dealers, who had been hoarding some forms of scrap, to let go of their accumulations, but this did not have the effect of breaking the market. During much of the year, steel making grades of scrap were shipped from this market to Pittsburgh, where there was heavy demand. When western mills began to need further supply, it was necessary to meet the Pittsburgh price and this brought about the sudden rise at the close of the year.

Railroad Buying

Selling of steel rails during 1915 was a comparatively late development. At the beginning of the year, rail mills found it difficult to book any considerable tonnage. Railroads were still skeptical and had not yet emerged from the poverty which had marked their condition for some time. A sale of about 35,000 tons of rails by the Algoma Steel Co., at Sault Ste. Marie, Can., was made early in the year and these rails were delivered by water at Chicago almost through the entire year. Railroads did not enter the market actively until heavy sales of other forms of steel had been made and rolling schedules had been arranged to put other products on rail mills. Large rounds and structural shapes had absorbed rail mill capacity and railroad orders were forced to take a back seat when they finally appeared.

Several instances of railroads in the hands of receivers obtaining court permission to buy rails resulted in tonnages being taken for delivery during 1916 without promise of making them available during the early part of the year.

Universal lathe chucks are very convenient to have in the shop but can rarely be depended on to run true if accuracy is desired in the execution of a piece of work.

American Ships for American Trade

THE PAST year witnessed an activity in ship building in the United States all the more remarkable because it took place in the face of unparalleled governmental discouragement. The revival of the American merchant marine brings a two-fold benefit to the iron and steel industry. It directly increases the demand for rolled products and also supplies the means for increasing our exports, a factor of increasing importance.

By C. J. Stark

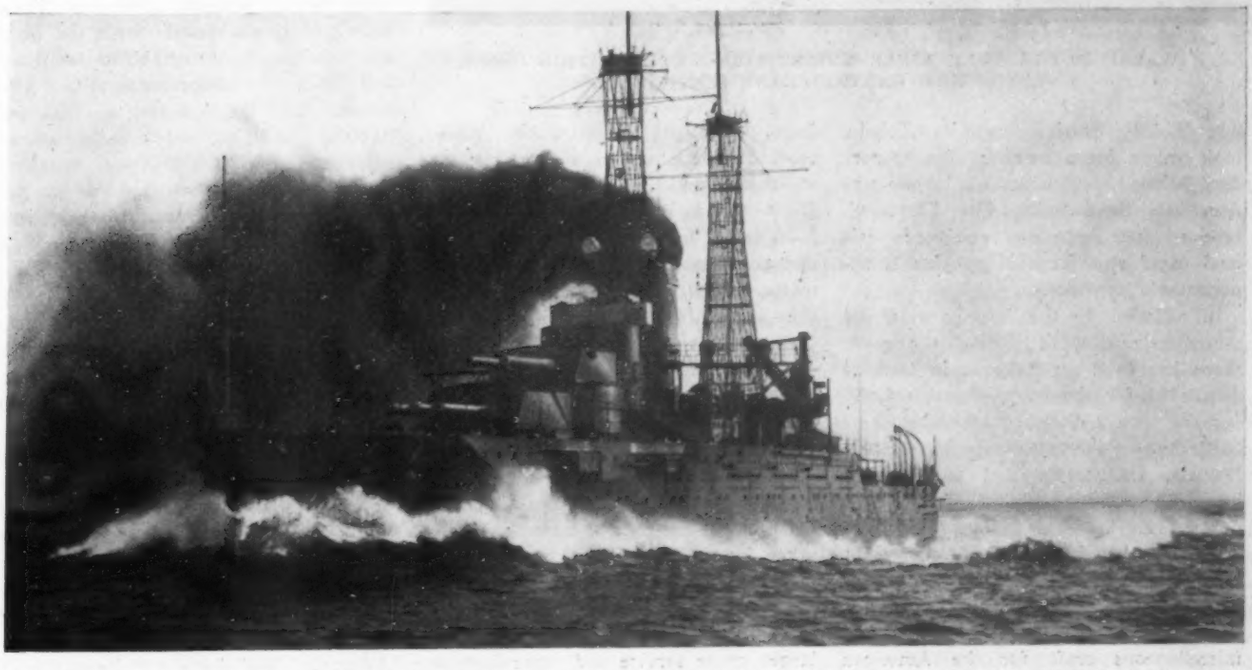
AMERICAN ship building for the high seas, for years decadent and neglected, made a fresh start in 1915. It quite surpassed itself by the tremendous vigor it developed. It established a dignity of magnitude and importance comparable with its traditional greatness of years long past, when the American flag, borne by American-built and American-manned craft, was familiar in every sea where trade or commerce flourished.

Modern ship building in the United States can show nothing to approach the record established during the year 1915. In their number and tonnage, the vessels ordered represent a tidy commercial fleet in themselves, a business asset that any nation might well be proud to possess. Approximately 120 merchant craft of the sea-going class, with an aggregate tonnage of more than 500,000, are actually under construction or entered on the order books of our builders. A year ago, the list of new merchant vessels on the ways did not exceed a dozen. Practically all the tremendous activity displayed in the upbuilding of a new American merchant marine, accordingly, has fallen within the past 12 months. That the volume of this work, impressive and perhaps significant of a new era in the nation's shipping history was not greater, has been due solely to the fact that all the available capacity has been crowded to the ultimate point. At the present time, any additional contracts accepted by the yards call for a delivery in from 18 months to two years. It is estimated that there are a score or more of vessels in the market at the present time, for which the owners are maneuvering to obtain the best possible delivery. That all of these contracts will be placed in due season, is confidently expected. The heavily engaged position of the coast ship yards for months ahead, has caused new work to overflow to lake plants. A number of contracts for ocean-going craft have been placed with builders at Detroit, Toledo and other fresh-water points.

The Ever Widening Circle

The rejuvenation of ship building in this country has impressed its effects upon other industries beyond itself. The iron and steel trade has profited hugely from this unparalleled recovery. If the total finally could be cast up, it probably would be found that the orders for ocean-going merchant boats, alone, called for not less than 350,000 to 400,000 tons of steel. Ship builders, especially those who were enlarging or opening new yards at the close of the year, were finding great difficulty in obtaining desired deliveries on steel. The great demand for ship plates has been one of the contributing causes for the strong market in this product which brought about the payment of premium prices over other heavy materials. It is manifest, therefore, that the maintenance of an active era of construction in home shipbuilding is of primary importance to the iron and steel industry, as a source of trade, making for greater stability and strength in the home market.

In large part, the vessels ordered during the past year are for American steamship and industrial companies engaged in the coastwise trade or in the commerce with other countries of the western hemisphere. In one instance, at least, the owner was an oil company controlled by British capital which is engaged in business between the American coasts. There has been enough of over-seas and foreign tonnage placed, however, to give the traffic

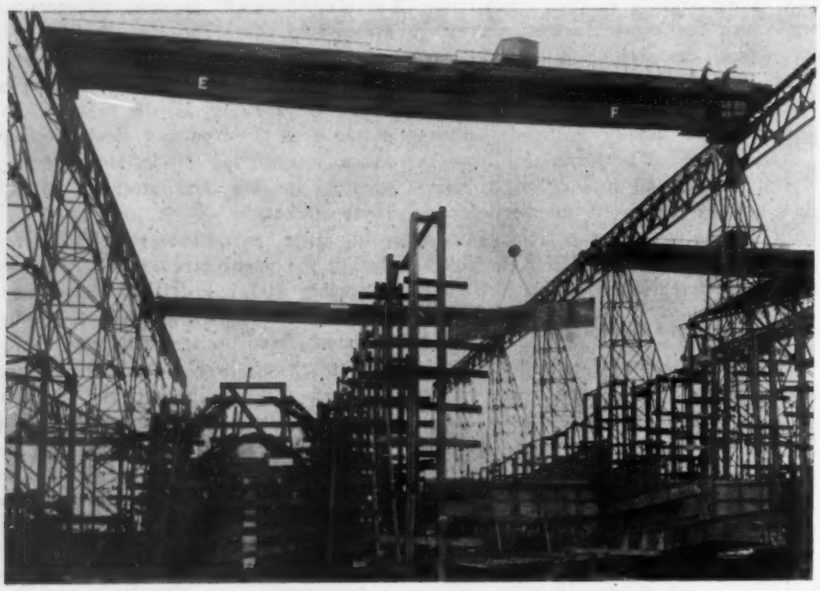


THE BATTLESHIP NEVADA, BUILT BY THE FORE RIVER SHIP BUILDING CORPORATION, ON HER RECENT TRIAL TRIP

a widely international character. Norwegian shipping interests, unable because of the war to place their work to advantage with European builders, awarded to the American yards perhaps a dozen freight ships. Three of these went to Chester, Pa., others to a Baltimore plant, and several to lake yards. Still others were under negotiation at the beginning of 1916. Tank vessels, principally for the oil trade, have been in extraordinary demand. The number of these awarded or built in 1915 was approximately 45. The Standard Oil Co. was the largest single buyer. This company and its allied interests placed about 25 of these ships. The Clyde Steamship Co., unable to find a berth on the coasts, placed three 2,500-ton ocean boats with the Great Lakes Engineering Works of Detroit. ordered an oil steamer from the Fore River Shipbuilding Co. and at the same plant, ten submarines were completed for the British government, to be shipped upon the conclusion of the war. The extensive manner in which the capacity of the shipyards now is occupied, undoubtedly, had a considerable measure of influence upon the action of the national administration in awarding the 1916 program of two battleships to government navy yards.

Much Capacity is Added

The natural result of the broad and rapid expansion of shipbuilding in this country in 1916, has been the construction of much new yard capacity and the rehabilitation to accommodate large vessels, of plants long since idle or capable of producing only minor craft.



SHIP WAYS OF THE FORE RIVER SHIPBUILDING CORPORATION, SHOWING THE NEW GANTRY CRANE SERVICE

The Toledo Shipbuilding Co., Toledo, took orders for a number of schooners for Atlantic ocean service, while the American Shipbuilding Co., Cleveland, received four or more vessels of Welland canal size from Norwegian transportation companies.

In addition to the large amount of the merchant work during the year, there has been an increase in tonnage demanded for the navy, almost entirely for the United States government. Five battleships—PENNSYLVANIA, MISSISSIPPI, NEVADA, OKLAHOMA and IDAHO—have been under construction during the year. The battleship MORENO for the Argentine republic was completed at the Camden yard. In addition, there have been under construction a number of destroyers, submarines, colliers and miscellaneous craft for the American government. The Argentine republic

From Bath to Tampa, the Atlantic coast has been visited with a wave of extensions and enlargements which has given the nation the largest industrial potentiality in its history for creating and maintaining a modern navy of commerce. New ways have been built by the Fore River Shipbuilding Co., Quincy, Mass., by the Maryland Steel Co., Sparrows Point, Md., by the Harlan & Hollingsworth Corporation, Wilmington, Del., and by other companies. Cramps at Philadelphia and the New York Shipbuilding Co. at Camden, N. J., have been carrying out important enlargements. The betterments undertaken by the Fore River company have been on a large scale. Apart from the new way, they have included a new plate shop, machine shop, power house, larger crane service and other improvements. The new way at this plant is of the double type, 138 feet wide and 800 feet long, capable of berthing the largest warship. The Chester Shipbuilding Co. acquired the old Roach plant at Chester, Pa., and has remodeled it for the construction of modern vessels. This company has orders for three boats for Norwegian shipping companies. The Standard Shipbuilding Corporation was formed to take over the Townsend & Downey plant on Shooters island, New York harbor, and will specialize in the production of modern steel ships of a limited number of standard types. The Continental Trading Co. was formed and acquired the old Mallory yards at Mystic, Ct. This company now is planning to build two Norwegian vessels. Many other changes of considerable importance have been wrought among Atlantic coast yards, all with the single purpose of constructing larger ships for the ocean-going trade.

Causes For the Revival

What are the underlying causes for this remarkable reversal from struggling existence to independent prosperity that has overtaken the shipbuilders of the country? Whatever they are, it is certain they are not of the making of the United States government, directly speaking. In fact, the great revival has been brought about despite not only the lack of constructive support on the part of the nation's present leaders but also in the face of crippling and obstructive legislation, of which the La Follette seamen's act stands out as a last word of folly. Happily, a set of circumstances beyond the control of the nation or any single set of men, has been the potent factor of the present movement. These have had to do mainly with the great war overseas and are both the direct and indirect consequences that have flowed from the complete readjustment of the world's commerce, attendant upon that conflict. The war has been the predominant influence which has precipitated the present situation; as a secondary and contributing cause, the Panama canal has been important.

It is clear that the war has brought about a shortage in the supply of ocean carriers, for the present needs of international trade. So many of the merchant vessels of the belligerent nations, which have included the two great maritime powers of the world, Great Britain and Germany, have been lost to the peaceful pursuits of commerce, by sinking, capture, interment or commandeering for army and navy purposes, that a serious stringency has arisen. Furthermore, British shipyards have been heavily engaged with work for the Admiralty, and have not been able to devote their energies to making up the

deficiencies in the present tonnage. These conditions have produced an unparalleled rise in transocean freight rates, especially in connection with the enormous export trade with practically all of Europe that has arisen in this country.

Some Fancy Freight Rates

At the present time, the rates being paid from this country to France, to the British Isles, to the Mediterranean and to other parts of the eastern hemisphere, are from six to seven times their normal level. Overseas shipping, consequently, has become most lucrative for the vessel-owner and has attracted into this traffic many ships which heretofore have not engaged in it. A considerable number of American vessels, built primarily for service between coast points, or with near-lying countries, are now engaged in the carrying trade between the United States and Europe at high returns to their owners. Some of the new ships now being built are to take their places in the coastwise trade. Concurrent with the increase of our export trade has come a corresponding broadening of the nation's business between its own coasts, and with South America, Central America, the West Indies, Hawaii and other countries of the western hemisphere. New trade routes have been opened and old ones extended, bringing forth a necessity for American-built ships such as never has existed before.

Many of these new enterprises have centered about the Panama canal and the shorter waterway between the coasts has been of tremendous importance in the upbuilding of this commerce. Over and above these new needs for a business navy for American industry, there also has been diverted to the shipyards of this country, considerable tonnage which, if it was to be built at all, had to be done in this country. This applies to ships which in the ordinary course of events, would have been constructed in English, German and other foreign yards.

The added feeling of security of operating these under the American flag for the present, at least, has not been lost sight of.

Future of Ship Building

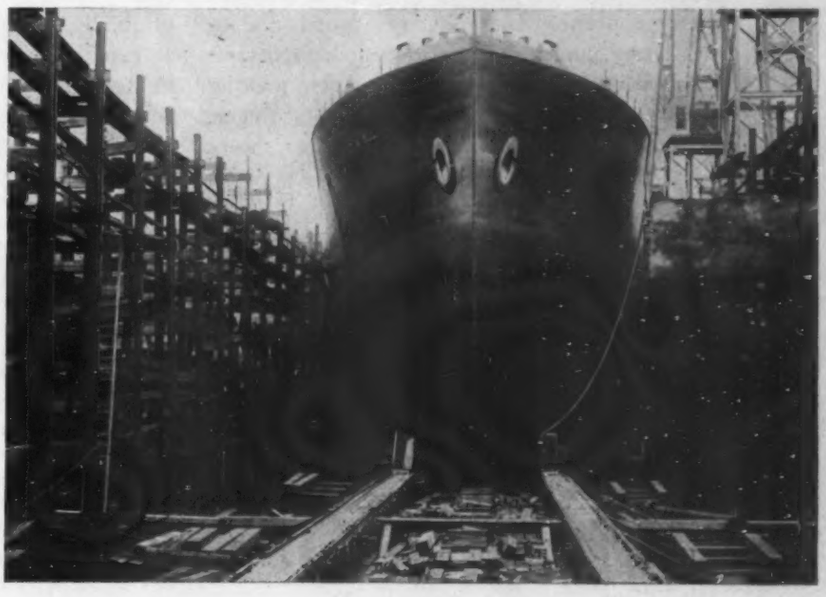
With the American ship yards assured of capacity operations for two years, at least, by the present work on hand, the question of greatest moment concerns their more extended future. The consensus of opinion among shipping men is that the answer to this question largely will be determined by the length of the present European war. The longer the conflict endures the stronger position the rejuvenated industry will attain, it is generally believed, and the less likely it will be that what now is being built up can be broken down by a recurrence of conditions such as existed before the war. It is pointed out, moreover, these old conditions are not likely to return when peace is concluded.

The yards of England and Germany are likely to be busily engaged for several years in restoring and repairing naval losses and in replacing the normal depreciation of merchant vessels used in the service of the government. Furthermore, it is not certain when these yards, now in the hands of the government, will be immediately turned back to their private owners. Nor is it likely that the organizations of these plants can be speedily assembled and restored to their former basis of efficiency. Right here appears the factor that the American ship builder is counting upon to work a radical change in his favor, as contrasted with antebellum conditions under which he found it impossible to compete against the European yards. Scarcity of skilled and trained labor and the increased cost of living, due to taxation for the huge war debt, reconstruction, etc., it is thought, are bound to result in high wages abroad; prices for iron and steel products will be on an advanced basis because of much new demand coupled, perhaps, with a reduced production.

A fair chance to compete is all the American shipbuilder asks. That means, obviously, that if he is not to be allowed direct or indirect government aid, he, at least, must not be obstructed at home by federal interference along untried and perilous lines such as has found its expression in the seamen's act, already proven absurdly destructive, and in proposals for government-owned steamships.

But, whatever may be the future position of the United States in international marine construction, it seems clear that the demand for ships for our coastwise trade and our commerce with South America, Central America, the West Indies and Hawaii, will be greater than ever before. The manner in which American manufacturers and exporters during the past year and a half, have cemented trade ties and alliances with these countries, points only to that end. That these will be maintained, can be read in the spirit of determination and completeness that has characterized the efforts. In the Panama canal, the nation has an asset and an aid to its coastwise and Latin-American commerce, the importance of which promises to be tremendous. Even before the war, the influence of this gateway between the oceans was beginning to stimulate and stir a new spirit and energy in American ship building.

"Give us four or five years of encouragement and the American ship builder will make himself felt," says the head of a large eastern yard. If the government will do its part, this encouragement will be forthcoming. There are multiplying evidences that among the lessons of the great war, brought home directly to the people of this country, none has been more impressive than the necessity for providing our own merchant marine. As a business proposition, this necessity is immediate; as a defensive measure, to neglect it is simply to gamble with fate.



LAUNCH OF THE TANK SHIP GOLD SHELL AT THE YARDS OF THE HARLAN & HOLLINGSWORTH CORPORATION, WILMINGTON

Review of Cincinnati Iron Market

ALTHOUGH the first half of the year just past was a period of light sales and general depression, the war's first birthday ushered in an era of excellent business. Southern iron sales were made on solicitation without previous inquiry, and No. 2 foundry iron climbed steadily. Prosperity also visited the coke manufacturers, who experienced no declines in prices. A record production is prophesied for the coming year.

By S. G. Backman

THE Cincinnati pig iron market during the year 1915 could be divided into two distinct periods. From Jan. 1 to Aug. 1, the situation was disappointing to producers, as inquiries and sales were extremely light, and prices would not respond to repeated efforts of dealers to advance them. From Aug. 1 until the end of the year, conditions were directly opposite. Inquiries were good, and at times heavy, and a number of foundries bought beyond what was supposed to be their melting capacities. Prices accordingly grew stronger, and after a series of rapid advances, were higher at the end of the year than at any time since the boom early in 1907, even surpassing the high mark in 1909. A good feature that characterized the market throughout the entire year, even during the dullest periods in the first half, was the lack of withholding of shipments on contracts, as melters continually asked that iron they had purchased be shipped as originally specified. This iron was consumed as rapidly as delivered, and the fact that stocks in foundry yards were not increased during the first six months of the year was a large factor in developing the extreme strength in

AT THE beginning of the year just passed, southern iron, which includes makes from furnaces in Alabama and Tennessee, was being offered at $9.50, Birmingham basis, for No. 2 foundry, for first half shipment. Very little iron was being sold, despite the fact that melters bought very sparingly during the last half of 1914. The market was in a weakened condition, for after having passed in 1914 through one of the gloomiest years in its history, the outlook did not offer any encouragement. Late in February, inquiries and sales began to improve when melters started almost in unison to buy for first half requirements. Efforts of several stacks at that time to advance the minimum quotation on No. 2 foundry from $9.50 Birmingham basis, to $10, were of no avail, for a number of stacks with large tonnages on their yards, were always willing to sell at the lower figure. This buying movement was short, for soon after the second week in March, the market lapsed back into the quiet state that existed at the beginning of the year. It was at that time that the low mark in the price of southern iron for 1915 was reached, for during the week of March 18 the minimum quotation for No. 2 foundry was $9.25, Birmingham basis, for first half delivery. A few stacks maintained $9.50 as their lowest quotation, but several declined to $9.25 in an effort to induce buying. The market remained at this low stage until the middle of April, when another buying movement of short duration was realized, and the price of No. 2 foundry was accordingly advanced back to $9.50, Birmingham basis. Inquiries fell away again early in May, but good shipments on old contracts and heavy consumption by melters gave the situation sufficient strength to not only hold prices, but to warrant another advance, making the minimum quotation $9.75, and the maximum $10, both Birmingham basis. Continued inactivity, however, began to show bad effects early in June, and during the second week in that month a few furnaces reduced their prices back to $9.50, Birmingham basis, for No. 2 foundry. Sales from June 10 to July 22 were extremely light, and the above price remained unchanged.

Market Becomes Stronger

Late in July, the feeling in the market began to grow better because of good shipments and heavy consumption of iron that were keeping furnace stocks from accumulating. In fact, it was about that time that dealers and melters in the Cincinnati district began to realize that consumption was fully equal to production. The first two weeks in August were featured by heavy buying of all grades of southern iron, including foundry, malleable and basic, with the former in the majority. Speculators at that time bought large tonnages of foundry iron which were not put upon the market until late in the year, and which, as resale iron, greatly retarded furnaces from advancing prices more rapidly as the year closed. Sales showed a rapid decrease after the week of August 26 and were never heavy again through September, October, November or December. Most business during the last quarter of the year was secured by salesmen purely through solicitation without previous inquiry. Prices began a rapid advance early in August, and were checked but once. During the weeks of Sept. 9 and 16, a few stacks, unable to sell at the then prevailing price of $11.50, Birmingham basis for No. 2 foundry, made concessions of $11 for last quarter shipment, and a good tonnage was placed at that figure. At the beginning of the week of Sept. 23, $11.50, Birmingham basis, again became the minimum quotation, and from then until the end of the year, advances of 50 cents a ton were realized almost each week, until late in December the high mark of $15, Birmingham basis, was reached. Thus the spread in price of southern iron during 1915 was from $9.25 to $15, Birmingham basis, for No. 2 foundry.

The southern Ohio market was more steady during 1915 than the southern market. Only one change in price was made during the entire first half on foundry iron, which includes makes from Ironton, O., Hanging Rock, O., Columbus, O., and Ashland, Ky., and that was a reduction on May 16 from $12.75, Ironton basis, for No. 2 foundry, at which price this iron began the year, to $12.50 for first half delivery. A good buying movement late in February and early in March did not bring higher quotations, as furnaces had such large tonnages piled in their yards that they were willing to sell at almost a sacrifice in order to keep the iron moving. Transactions became low again about the middle of March and did not im-

prove until the middle of April. During the latter month, three large consumers in the Cincinnati district, the American Rolling Mill Co., Middletown, O., the Andrews Steel Co., Newport, Ky., and the Whittaker-Glessner Co., Portsmouth, O., each purchased from 30,000 to 40,000 tons of basic iron, at prices slightly below those quoted for foundry grades, which latter ranged from $12.75 to $13, Ironton basis. Towards the last of April, demand for foundry and basic iron diminished to a minimum, but users of malleable iron suddenly came into the market early in May and bought large tonnages, especially during the week of May 7. Despite these activities, the price of No. 2 foundry declined during the week of May 13, from $12.75, Ironton basis, to $12.50, Ironton basis, for second and third quarter shipments. Malleable sales fell away during the week of May 20, and from that time until the week of July 22, the market was extremely quiet and devoid of feature. Late in July, a feeling of confidence came over furnace operators, because of heavy shipments of basic, foundry and malleable iron on contracts, and investigations by salesmen showed that none of this iron was being piled in foundry yards, but was being consumed as fast as delivered. Stocks in furnace yards were also being steadily reduced. The price of No. 2 foundry was therefore advanced during the week of July 29, from $12.50, Ironton, to $13. Early in August, another good buying movement developed, and heavy basic sales, aggregating 100,000 tons in two weeks, were made to the three consumers mentioned above in addition to the Kokomo Steel & Wire Co., Kokomo, Ind. Demand for foundry and malleable grades at that time was also heavy, and the situation reached its high mark of the year in the number and size of transactions made. From the first week in September until the last in December, demand was below normal, but furnaces were so well sold up through the last quarter and well into the first quarter that prices were exceptionally strong, and were advanced almost regularly each week, until the high level of $18, Ironton basis, for No. 2 foundry, had been reached at the close of the year.

Silvery Iron

Jackson, O., and Ashland, Ky., showed about the same characteristics during 1915 as foundry iron from southern Ohio. The price of eight per cent silicon at the beginning of the year was $15.50, furnace, for first half delivery. When a good demand came out in March, furnaces were so anxious for business that they cut prices, with the result that the level dropped from $15.50 to $15.25 furnace, during the week of March 11, and again from $15.25 to $14.75, furnace, during the week of March 25. This price remained unchanged until late in July, when an almost phenomenal advance began, which resulted in December in a strong quotation of $25, furnace, for eight per cent silicon, for second quarter shipment, with a premium asked for the first quarter because of scarcity for that delivery.

The price of southern coke did not decline at any time during 1915. Coke operators in the Wise County, Pocahontas and New River districts kept only a sufficient number of ovens in blast during the first half to supply shipments, and sold a portion of their coal direct.

Shipments of foundry coke grades were very heavy during the last half, and at the close of the year demand was better than supply. Furnace coke sold spasmodically during the year. At the close of the year, quotations on all grades and makes became stronger, and another advance seems certain early in the first half. Consumption is heavier than production, but the latter is now apparently at its height. Spot coke is at a premium, and unless sudden and unforeseen reverses are experienced, oven operators appear to be entering, in 1916, one of the best years in the history of the market.

PRICES OF SOUTHERN NO. 2 FOUNDRY IRON

Month.	Average minimum price Birmingham basis.	Average minimum price Cincinnati basis.	Average maximum price Birmingham basis.	Average maximum price Cincinnati basis.
January	$ 9.50	$12.40	$10.00	$12.90
February	9.50	12.40	10.00	12.90
March	9.38	12.28	9.82	12.72
April	9.35	12.25	9.75	12.55
May	9.75	12.65	10.00	12.90
June	9.57	12.47	10.00	12.90
July	9.62	12.52	10.10	13.00
August	11.00	13.90	11.50	14.40
September	11.30	14.20	11.83	14.73
October	11.75	14.65	12.63	15.53
November	13.13	16.03	13.63	16.53
December	14.13	17.03	14.33	17.23

PRICES OF SOUTHERN OHIO NO. 2 FOUNDRY IRON.

Month.	Average minimum price Birmingham basis.	Average minimum price Cincinnati basis.	Average maximum price Birmingham basis.	Average maximum price Cincinnati basis.
January	$12.75	$14.01	$13.00	$14.26
February	12.75	14.01	13.00	14.26
March	12.75	14.01	13.00	14.26
April	12.75	14.01	13.00	14.26
May	12.56	13.82	12.81	14.07
June	12.50	13.76	12.75	14.01
July	12.60	13.86	12.90	14.16
August	13.63	14.89	13.92	15.18
September	14.20	15.46	14.83	16.09
October	14.88	16.14	15.31	16.57
November	16.13	17.39	16.25	17.51
December	17.00	18.26	17.33	18.59

PRICES OF SILVERY IRON, 8 PER CENT SILICON.

Month.	Average minimum price furnace.	Average minimum price Cincinnati.	Average maximum price furnace.	Average maximum price Cincinnati.
January	$15.50	$16.76	$15.75	$17.01
February	15.50	16.76	15.75	17.01
March	15.19	16.45	15.63	16.89
April	14.75	16.01	15.25	16.51
May	14.75	16.01	15.25	16.51
June	14.75	16.01	15.25	16.51
July	14.80	16.06	15.25	16.51
August	16.13	17.39	16.63	17.89
September	16.80	18.06	17.30	18.56
October	18.38	19.64	18.88	20.14
November	21.00	22.26	21.50	22.76
December	24.75	26.01	24.75	26.01

AVERAGE MONTHLY PRICES OF SOUTHERN COKE FOR 1915, PER TON, OVENS.

	Wise County		Pocahontas		New River	
	Furnace.	Foundry.	Furnace.	Foundry.	Furnace.	Foundry.
January	1.75-2.00	2.10-2.40	1.75-2.00	2.00-2.25	2.00-2.25	2.50-3.00
February	1.75-2.00	2.10-2.40	1.75-2.00	2.00-2.25	2.00-2.25	2.50-3.00
March	1.75-2.00	2.10-2.40	1.75-2.00	2.00-2.25	2.00-2.25	2.50-3.00
April	1.75-2.00	2.10-2.40	1.75-2.00	2.00-2.25	2.00-2.25	2.50-3.00
May	1.75-2.00	2.10-2.40	1.75-2.00	2.00-2.25	2.00-2.25	2.50-3.00
June	1.75-2.00	2.18-2.45	1.75-2.00	2.00-2.25	2.00-2.25	2.50-3.00
July	1.75-2.00	2.25-2.50	1.75-2.00	2.00-2.25	2.00-2.25	2.50-3.15
August	2.00-2.25	2.40-2.60	2.00-2.50	2.25-2.50	2.25-2.50	2.50-3.25
September	2.00-2.25	2.40-2.60	2.00-2.50	2.25-2.50	2.25-2.50	2.50-3.25
October	2.25-2.40	2.50-2.70	2.25-2.55	2.35-2.70	2.35-2.55	2.60-3.30
November	2.65-2.85	2.85-3.15	2.65-2.85	2.85-3.15	2.85-3.15	3.15-3.30
December	2.75-3.00	3.00-3.25	2.75-3.00	3.00-3.25	3.00-3.25	3.25-3.50

Judge Gary Issues Word of Warning

New York, Jan. 4 (By wire).—Judge Gary, in a long statement covering conditions and prospects of the iron and steel industry, struck a note of warning against over production, over extension and over confidence as the result of the present feverish prosperity.

"We must be prepared for radical changes in volume, in prices and in resources," he said. Further he added, "This is an epoch. The times are serious, perhaps critical. The financial, commercial and industrial interests of the country may be firmly established on an independent and invulnerable foundation, but there must be cooperation between all classes and departments, private and public. Governmental power must lend its assistance to legitimate private work and the latter must appreciate and reciprocate."

Judge Gary said he feared there is great inflation at present and that there will be jars and jolts later. Now is the the time to ponder, stop and reason. The end of the war will bring new conditions. Competition then from foreign producers will be most persistent and the most difficult ever faced by American manufacturers. Most foreign countries then will be protected by tariffs and Judge Gary said we must have similar treatment on scientific principles. The question of how long present prosperity continues will depend upon ourselves and the nation's leaders.

Judge Gary said the present output of the country is at the rate of 38,000,000 tons of iron and 41,000,000 tons of steel annually. About 75 per cent of the present bookings are for domestic consumption and the rest for foreign, directly and indirectly.

Judge Gary expresses himself as believing the war will end more quickly than most people think, because of the exhaustion and gradual realization by different people that no benefit can come from it. He believes the present iron and steel prosperity is assured for six months.

James H. Grose on New Year's day succeeded Thomas McDonald, general superintendent of the Youngstown, O., district for the Carnegie Steel Co. I. Lamont Hughes, becomes assistant district superintendent.

H. A. Butz has been appointed chief engineer of the Donner Steel Co., Inc., Buffalo. He was formerly chief engineer of the Dominion Iron & Steel Co., Sydney, N. S., recently with the H. Koppers Co., of Pittsburgh, and was engineer in charge of construction of the plant of the New York State Steel Co., Buffalo, for the Garrett-Cromwell Engineering Co., Cleveland.

The average price of bessemer and basic pig iron in December was $19.021 and $17.487, valley, respectively, according to figures compiled by W. P. Snyder & Co. Compared with averages for the preceding month, bessemer iron in December advanced $2,406 and basic $1.969.

Four New Stacks

Will Be Added to Gary Plant—Other Corporation Improvements

New York, Jan. 4 (By wire).—New open hearth extensions authorized by the United States Steel Corporation include four 75 to 100-ton furnaces for the National Tube Co., at Lorain, where also a 40-inch blooming mill will be added. Three 75 to 100-ton furnaces will be built at Ohio works, Youngstown, one 60-ton furnace at Newburgh, and three 60-ton furnaces with 1,000-ton mixer at Donora, where also additional rod mill capacity is being built. At Bellaire, blast furnace No. 1 is being rebuilt. At Edgar Thomson, blast furnace No. 1 is being rebuilt, and other furnace yard improvements made. At the Shelby plant, Ellwood City, Pa., mills *A* and *B* are being enlarged and rebuilt at its Cuyahoga works, a new rod mill and additional wire drawing and galvanizing equipment are to be installed.

The most important improvement of all is at Gary; it includes four blast furnaces; a 40-inch blooming mill, a 160-inch plate mill, and two 10-inch and one 20-inch merchant mills. Duplexing units will be built in Gary and South Chicago.

Prices Present and Past

Quotation on leading products January 5, average for December, 1915, average for October, 1915, and average for January, 1915. Prices are those ruling in the largest percentage of sales at the dates named.

	Prices Jan. 5, 1916.	Aver. for Dec., 1915.	Average for Oct., 1915.	Aver. for Jan., 1915.
Bessemer pig iron, Pittsburgh..	$21.45	$19.85	$16.95	$14.70
Basic pig iron, Pittsburgh.....	19.45	18.55	15.95	13.45
No. 2 Fdy. pig iron, Pittsburgh	19.95	18.85	15.57	13.70
Northern No. 2 Fdy., Chgo....	18.50	18.10	14.44	13.00
Lake Superior Charcoal, Chgo..	19.25	19.15	16.25	15.75
Mall., Bess., Chgo.....	19.00	18.10	15.12	13.00
Southern No. 2, Birmingham...	14.50	13.50	11.50	9.50
Southern Ohio No. 2, Ironton..	18.00	16.25	14.50	12.63
Basic, eastern Pa.....	18.50	17.75	15.25	13.50
No. 2X Virginia furnace.....	17.25	15.50	12.75	12.50
No. 2X foundry, Philadelphia...	19.75	17.75	15.00	14.25
Ferro mang., Balti., (prompt)..	110.00	100.00	110.00	68.00
Bessemer billets, Pbgh.....	34.00	29.60	25.50	19.50
Bess. sheet bars, Pbgh.....	34.00	30.80	25.50	20.00
Op.-h'th sh. bars, Pbgh.....	35.00	30.80	26.50	20.00
Open-hearth billets, Pbgh.....	35.00	30.20	26.50	19.50
Steel bars, Chgo.....	2.19	1.97	1.59	1.29
Steel bars, Pittsburgh.....	2.00	1.74	1.41	1.10
Iron bars, Philadelphia.....	2.159	1.759	1.459	1.15
Iron bars, Cleveland, local del'y.	2.00	1.75	1.39	1.15

	Prices Jan. 5, 1916.	Aver. for Dec., 1915.	Average for Oct., 1915.	Aver. for Jan., 1915.
Iron bars, Chgo. mill.....	$1.75	$1.70	$1.37	$0.98
Beams, Chgo.	2.19	1.97	1.59	1.29
Beams, Pittsburgh	2.00	1.74	1.41	1.10
Beams, Philadelphia	2.159	1.759	1.509	1.20
Tank plates, Pittsburgh.....	2.00	1.74	1.42	1.10
Tank plates, Chicago.....	2.19	1.97	1.55	1.28
Tank plates, Philadelphia.....	2.159	1.759	1.509	1.20
Sheets, blk., No. 28, Pbgh.....	2.60	2.54	2.05	1.80
Sheets, blue an., No. 10, Pbgh.	2.25	2.23	1.60	1.30
Sh., galv., No. 28, Pbgh.....	4.75	4.75	3.50	2.77
Wire nails, Pittsburgh.....	2.10	2.02	1.76	1.55
Connellsville fur. coke, contr...	2.35	2.35	2.25	1.69
Connellsville fdy. coke, contr...	3.00	3.00	2.48	2.25
Heavy melting steel, Pbgh.....	17.50	17.50	14.00	11.62
Heavy melting steel, east'n Pa..	16.50	14.50	14.50	9.50
Heavy melting steel, Chgo.....	15.50	15.40	11.56	8.87
No. 1 wrought eastern Pa.....	22.00	17.00	16.00	11.50
No. 1 wrought, Chgo.....	15.50	15.15	10.68	8.81
Rerolling rails, Chgo.....	17.75	14.31	13.15	9.50
Car wheels, Chgo.....	14.75	14.75	11.75	10.00

Very Heavy Specifications Roll In

Buyers Anxious to Get All Tonnage—Pig Iron Policy for Last Half Develops—Advances in Finished Materials

A FLOOD of specifications on all kinds of finished materials came to the offices of the steel companies during the last few days of the old year. Seldom, if ever, in the history of the trade has there been such a complete clean-up, as buyers were anxious to get every pound of material for which they had contracted. The new year opened under very favorable conditions with mills and furnaces doing their utmost to meet the continued strong demand. The congestion in the east is still very serious, but exporters who are so fortunate as to have vessels to carry products to foreign lands are finding it easier to obtain shipments to the seaboard, and during the past week, there has been a freer movement from Buffalo and other points. A vast volume of inquiry for steel for the entante allies is still pending, but the high prices asked are having a tendency to check the entering of orders and representatives of foreign governments assert that it will not be necessary for them to order immediately, as munition making plants in England are turning out constantly increasing tonnages and France is understood to have considerable tonnages in reserve. Foreign buyers say that they expect the market to be more nearly normal toward the close of the first quarter of the year than it is at present.

The earnest words of warning uttered by Judge Gary at a time of most unusual conditions will receive the thoughtful attention of not only the iron trade, but also of all men who wish to see business conducted in a conservative manner. The chairman's position is in harmony with the Corporation's policy to adhering to moderate prices and refusing to accept premiums for prompt delivery. Its new construction program, although extensive, has been most carefully planned to meet what seem to be imperative requirements.

Pig Iron

During the past week, the selling policy of furnaces along the lakes and in the Mahoning and Shenango valleys for sales covering the last half of the year has developed more definitely. Nineteen dollars has been named on malleable No. 2 foundry by leading sellers in those districts. In the valleys, some sellers were in favor of quoting $20 on No. 2 foundry, but the outlook is that the $19 quotation will prevail. At Chicago, northern malleable has been advanced by leading producers to $19, Chicago furnaces, and others are expected to follow very soon. No. 2 foundry iron is still quoted at $18.50 at Chicago, but probably will follow malleable to $19. In the Buffalo district, melters are showing more interest in last half iron and one furnace company that started to book for last half at $18 now has $19 as its minimum. In eastern territory, the National Enameling & Stamping Co. is inquiring for 10,000 to 15,000 tons of basic for delivery in the last half of the year. A Phillipsburg, N. J., cast iron pipe maker has closed for 3,000 to 4,000 tons of foundry iron for last half. Inquiries from abroad include 5,000 tons for Wales, 2,000 tons for Italy and 2,000 tons for France, all steelmaking iron. In the Philadelphia district, sales during the past week have been rather moderate. They include 3,000 to 4,000 tons for last half taken by an eastern pipe maker. At Pittsburgh, few sales have been reported, but a steel manufacturer has purchased 5,000 tons of bessemer for first half delivery at $21, valley, and an eastern melter has taken 6,000 tons of basic at $18, valley. The southern pig iron market is strong, with $15 to $15.50, Birmingham, prevailing for the first half and from $15.50 to $16.50 for the second half, although a limited tonnage is being sold at slightly lower figures.

Prices

The price tendency on finished materials continues upward. On shapes, plates and bars, the minimum of United States Steel Corporation subsidiaries is now 1.85c, Pittsburgh, but delivery is not guaranteed and to obtain anything like prompt delivery high premiums must be paid to other companies. The American Sheet & Tin Plate Co. has followed other manufacturers in advancing its price on tin plate from $3 a ton to a basis of $3.75 per hundred pounds. The National Tube Co. has advanced its quotations on standard pipe $2 per ton and advances of $1 to $2 have been made on oil country goods, while line pipe and merchant casing have been marked up $2 per ton. Prices of wrought iron pipe are also being advanced. The minimum quotations on billets and sheet bars are now $34 and $35, Pittsburgh, respectively, with very little tonnage obtainable at any price, and small tonnages of billets have been sold as high as $50. An eastern plate maker which now has actual specifications for its full output to August has advanced its minimum price $5 a ton to 2.50c, Pittsburgh, and will quote only on most desirable business. Blue annealed sheets are quoted 2.50c to 2.60c, Pittsburghh, for No. 10, and the tonnage for sale is very limited. Spelter has been advanced $3 per ton. Prices on packers' cans have been marked up sharply.

Pig Iron Production

December's pig iron production shows a gain of 165,403 tons over November. The output was 3,035,235 tons for December and 29,572,194 tons for the year, exceeding 1914 by more than 6,500,000 tons, but a million tons less than the record production of 1913. The number of active stacks made a gain of 10 in December over November.

THE OPEN HEARTH

Building on a Rock

AS THE iron and steel trade is said to be the barometer of our national prosperity, it is likewise true that the faith of an industry in future prosperity is gaged by the character of its new construction. From coast to coast, from the boundaries of the Canadian border to the gulf, there is an amazing activity in the building field. A general resume taken from the new construction pages appearing in each issue of *The Iron Trade Review,* extending over the past six months, bears indisputable evidence of faith in the stability of present conditions.

No longer do advices from concerns making improvements inform us that the changes or extensions are "of a temporary nature only". It is gratifying to note that "concrete and steel, with all modern improvements" prevail in building specifications. No longer are projects hanging fire from month to month, lacking, apparently, the financial sinews for completion. Civic improvements, private enterprise and government projects have felt the stimulus and contracts for big jobs have been awarded with a vigor that has affected every line of industry. We are building for the future on the foundation that American industry will weather the storm of competitive foreign commerce and hold its place with befitting dignity.

The Story of the Year Told by Charts

THE intensely interesting developments of a wonderful year in the iron trade are reviewed at length in this number by associate editors of *The Iron Trade Review* in New York, Pittsburgh, Chicago, Cincinnati and Birmingham, Eng., and supplementing these reviews are a number of charts in addition to those heretofore published in connection with annual review issues of *The Iron Trade Review.* Two charts printed on one sheet in colors show the fluctuations of prices during a period of 21 years. Figures on which the charts are based are the prices published in the market reports of *The Iron Trade Review.* They are computed for the following: Tank plates, Chicago; beams, Pittsburgh; bar iron, Cleveland; bessemer billets, Pittsburgh; bessemer pig iron, Pittsburgh; No. 2 foundry, Chicago; southern gray forge, Cincinnati; No. 2 foundry, Birmingham; steel bars, Pittsburgh. Owing to the growing importance of basic pig iron, a line, showing prices of that grade for 1915 has been added to the chart.

In the chart for the past five years, the vertical lines represent weeks, while in the chart covering the 16 preceding years, the vertical lines represent months. In the two charts, the horizontal lines show prices in dollars per net ton in the case of finished material and per gross ton in the case of pig iron and steel billets. The solid and broken lines traversing the diagram indicate changes in prices at which a very large percentage of the tonnage was placed, but do not show the highest or lowest prices at which some tonnage may have been placed. This is a point which it is well to remember, particularly this year, when some sales for prompt material have been made at much higher prices than those on the chart. In the case of pig iron, the minimum quotations for prompt delivery are used.

The lower chart shows the very short-lived boom in 1895, which followed the period of depression; then the decline in the latter part of 1895, followed by the slow general decline of 1896 and 1897, when in mid-summer the lowest prices on record prevailed; the rather steady trend of prices from the middle of 1897 to the fall of 1898; the rapid rise at the close of 1898, followed by the very high quotations of the boom year, 1899; the sharp decline, beginning in September, 1899, and continuing until the mid-summer of 1900; a partial recovery at the close of 1900, and the continuance of prices upward during 1901; the rapid advance during the first half of 1902 and sharp decline, beginning in the fall of 1902 and continuing during 1903, followed by a long period of prosperity, with occasional recessions, ending suddenly in October, 1907, with the panic of that period.

Owing to the co-operative policy, which prevailed in 1908, there was more regularity in prices than would have prevailed without it, but following the declaration of the open market in 1909, prices declined rapidly. Upward tendency marked the last half of the year, but in 1910 prices again declined and the downward tendency continued through 1911. Recovery was not well under way until June, 1912, but the last of that year made decided gain. In 1913, weakness developed in pig iron early in the year and this extended to finished materials, so that by July 1, the downward trend was marked. The year 1914 was one of weakness in prices and general business depression, but owing to the low level, which prevailed at the close of 1913, the prices at the close of 1914 were not much lower than at the beginning of that year. In pig iron, especially, the chart for 1914 is remarkable in showing smaller fluctuations than in almost any twelvemonth during the 21-year period. The chart clearly shows that in 1915 finished materials felt the stimulus of improved demand early in the year, but prices of pig iron were almost stationary up to July 1. During the last half of the year in finished materials and pig iron, and particularly in the last quarter, price advances were very rapid. Although the lines of the chart do not show the highest prices today on shapes, plates and bars for prompt delivery, it is evident that the advance

THE OPEN HEARTH

of the past few months has seldom been equaled in earlier years, although the peaks of 1899 and 1902 still tower above those for 1915.

It is a noteworthy fact that the highest peaks are pointed sharply, showing that declines come quickly when very high prices are recorded.

For the first time, *The Iron Trade Review* publishes this year a chart, showing fluctuations of nonferrous products closely connected with the iron industry. The fluctuations in spelter in 1915 had extraordinary influence on galvanized sheets and for this reason the prices of galvanized sheets are recorded on the chart. Pig tin and lead have likewise been factors in the tin plate and terne plate markets.

On another sheet, published as a supplement, charts show in graphic form prices at ovens of Connellsville furnace coke for prompt delivery from 1909 to 1915; production of coke and anthracite pig iron in the United States from September, 1907, to November, 1915; unfilled tonnage of the United States Steel Corporation from 1910 to 1915, the net earnings of the Corporation from 1902 to 1915, and lake shipments of iron ore from 1905 to 1915. Thus, in small space, a very large amount of information is presented.

King of All

COMMANDING in importance to the material well-being and advancement of the nation and of the individual in times of peace, the iron and steel industry now is effectively demonstrating its true character as the bone and sinew of a people in the supreme hour of war. Strength, resistance, solidarity, qualities of itself as a material, it imparts to the nation which is so fortunate as to possess it broadly and so wise as to develop it to its utmost power.

In its farthest analysis, the key to Germany's remarkably successful struggle against numerically and financially superior foes lies in iron and steel. Reversely, the ineffectual efforts of the allies up to date have been the result of their unpreparedness in the essential resources and the materials of modern war, which are, largely, iron and steel. Whatever may be said in the final survey of Germany's strategy, her full appreciation of the vital part that the iron and steel industry was to play in the world's greatest conflict is clear. In swiftly possessing herself of the whole iron and steel industry of Belgium and of the principal producing districts of France and Russia, she sought to deal a fatal blow to her antagonists, the force of which has driven her foes to draw heavily upon the United States to sustain themselves. Today, Germany controls more iron and steel capacity, by far, than the combined tonnage of all the countries with which she is at war. Before the war, her output of steel just about equalled that of England, France, Belgium and Russia.

In the light of the facts brought home by the conflagration of Europe, the United States well may ponder with profit. Its iron and steel capacity, already great industrially, stands anew as a bulwark of natural strength and safety. The unhampered development of the industry would enable it to render very great public service; to interfere with its widest legitimate exploitation by legislative act or policy is to strike a blow at a most important national safeguard.

A Real Santa Claus

SEVERAL years ago, an unusually successful campaign was inaugurated to induce school children living in Pittsburgh and its vicinity to save their money. "One hundred pennies make a dollar," they were told by their parents and teachers. Thousands—yes, scores of thousands—of school children opened savings accounts.

Forty-one thousand boys and girls had deposits in the Pittsburgh Bank for Savings, which was forced to close its doors a few days before Christmas. These youngsters had more than $167,000, or an average of about $4 each, on deposit in the defunct bank. Their pennies might be tied-up for an indefinite period. The Yuletide season was beclouded by the suspension of the bank, it is needless to say.

By an inspiration breathing the very spirit of the festival, which is peculiarly the children's very own, as the *Pittsburgh Dispatch* commented, Henry Clay Frick went to the relief of the children. He offered, on Christmas morning, to make good their deposits, penny for penny, dollar for dollar! "It was just because it was Christmas," modestly explained Mr. Frick.

Fifty-two years ago, Mr. Frick worked in a country store for $3.50 a week; he lived in a small room in a miner's hut. Possibly it was his childhood struggles that inspired him to become a living Santa Claus to the 41,000 children affected by the closing of the Pittsburgh bank. Surely, no more beautiful spirit could be manifested than that displayed by Henry Clay Frick.

The action of Mr. Frick was, however, not essentially different from that of many employers throughout the country who by their generous action in sharing profits with employes have shown a spirit highly to be commended. Unfortunately, some employes by going on strikes shortly before the holidays deprived themselves of the privilege of sharing in profits which accrued earlier in the year. Speaking generally, however, the labor situation in the country is at present very satisfactory and the outlook for a continuation of pleasant relations of employers and employes is pleasing. May the holiday spirit of generosity and justice prevail throughout the year!

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By R. V. Sawhill

CHARLES M. Schwab's fifteen-year-old prediction is about to be realized. In 1900, he prophesied that by 1920 the United States would be producing steel at the annual rate of 40,000,000 tons. The output this year may not quite reach that figure, but the capacity will be available. A continuation of the demands made on steelmakers during the past six months, is almost certain to bring production close to the mark set by Mr. Schwab, and at the end of only four-fifths of the time allotted.

The past few months of unrelenting demand for steel has brought with it, almost as a natural corollary, a sharp revival of open hearth furnace construction. Announcements of authorized or projected increases in steelmaking capacity have issued in a steady stream from the offices of a large number of iron and steel companies. And with demand at flood tide, authorized increases are quickly put under construction, while projected additions are as readily authorized.

This desire on the part of the steelmaking companies to increase their output, has not escaped the skeptical criticism of many close followers of the iron and steel markets. These observers point out the abnormal character of the war business taken during the past months, and having in mind the idle steel plants of 1914, see in the large increases being made, only so much additional excess capacity when peace is declared.

Arrayed against this view, we have not only the expressed opinions of the executives of many of the largest steel companies in the country, but their willingness to turn their larger earnings back into their properties. With so many of the leading figures of the iron and steel industry backing their opinions with cash, it is of interest to analyze the factors which provoke this optimism.

The fate of the man who is a "bear on the future of the United States" is familiar to all of us. The American steelmaker has never been accused of discounting the future of his industry from the bear side. Men of 60, who began service in iron and steel plants when 20 years old, have witnessed the output of steel surge upward from less than 400,000 tons to more than 31,000,000 tons. They have seen good years follow lean ones, prosperous times succeed depressed periods and increased demand come after a slackened one. The collapse predicted after the great railroad building era of the nineties failed to materialize, as the extension of the uses for steel more than balanced the falling off of railroad orders. With every instinct of his training calling for a bullish outlook, it is little wonder that increases in capacity are readily authorized.

The estimated steel producing capacity of the country was set in these columns last year at 37,500,000 tons. The actual rate of production during the closing months of 1915 was more than 38,000,000 tons. This latter fact furnishes not only a verification of the estimate made by *The Iron Trade Review*, but at the same time indicates that all available furnaces, including, of course, those built last year, have been pressed into service. With practically every steel plant assured of capacity operations during this year, it appeals to many as only a part of business judgment to build additional furnaces to meet the unsatiated demand.

Another argument that has led many companies to build more furnaces, is the probability that with the prices now ruling, it will be possible to pay for the improvements with the earnings from the first year's operations. This same argument has brought, from the idle ranks, many mills which have been carrying an apparently hopeless burden of debt, which the war demand, at first alone, but now in conjunction with a healthy domestic influx of orders, furnishes an opportunity of removing.

From a purely domestic viewpoint, what can the steelmaker expect from those customers whose patronage furnishes the bulk of his business? Conditions in the railroad field are well known. A pinching policy enforced by deficits or decreased earnings has given way to a constructive one of replacements and renewals, possible because of large revenues. With so much capacity tied up on foreign orders, many railroads have continued to hold back orders which the release of American capacity, or a softening of prices, would bring out. The immense tonnage of steel taken annually by automobile manufacturers has not diminished and increased numbers of motor cars are provided for and manufactured each year. While structural shapes have not shared as fully in the general demand as some of the other lines of steel products, domestic inquiry now embraces practically all lines of finished materials and is constantly growing.

The searchlight thrown on conditions in the American merchant marine by the European war has led not only to a ship building program that has stocked most yards for 18 months, but may bring about the long-delayed permanent revival of American ship building with its consequent opening of a larger field for the steel producer. In addition, an increase in the government's army and navy appropriations is highly probable. From sheet mills, manufacturers of semi-finished steel seem assured of a constantly widening market. The uses to which sheets may be adapted are being revealed almost daily and the confidence of the sheet mill interests in the future of their business is shown by the large number of new plants built in the past few years. In this connection, it must be remembered that the percentage of scrap return on sheets is small, so that the semi-finished steel required follows closely any increase in the demand for the finished product.

Thus from a study of the domestic market, it is apparent that the naturally optimistic steelmaker found a substantial basis for his belief that additional steel-producing units were needed.

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especially for making war munitions, and the expectation of a wider field for exporting American steel products. The reason for building these war plants is analogous to one of those given above for adding open hearth furnaces. The builders were practically assured of paying for the complete plants from their profits during the first year, and were willing to risk the chance of continuing them in operation after the abnormal demand had subsided. That these plants will operate is a certainty. Their effects on older establishments is problematical. A study of the American iron industry will show that the construction of semi-finished steel units operates in a cycle opposed to that of finished units. In other words, when demand is light, steel company executives broaden their finishing capacity so that they may extend the market for their products. With the resumption of a healthy inquiry, there is a rush to add semi-finished steel-producing units to furnish material for the order-filled finishing mills. The adaptability of the American steel manufacturer has been shown on numerous occasions in the past, in converting his finishing capacity to uses other than those for which it was originally designed. The increase in finishing capacity brought about by the erection of plants for meeting a purely temporary demand, will thus necessarily bring about the adaptation of many finishing mills to the production of special products so that we may expect a considerable number of these mills to operate after the war, with a consequent larger demand for steel.

As for the export field, many factors encourage an optimistic viewpoint. American steel products already have been introduced into fields which they had never entered previously. With the re-entrance of European mills into the battle for world trade, competition will assuredly be bitter, but to offset this, we have the entry of American bankers into the foreign fields, both through branch agencies and through exporting companies. American money invested in a foreign country carries with it the assurance of money spent for American steel products needed in the particular projects being exploited. Coupling this with the announced attitude of some of the high officials of the present administration relative to permitting manufacturers to combine to secure foreign trade, we realize why the export field already is attracting more attention from the iron and steel industry of this country than ever before, with cheerful prospects for the future.

The principal reasons why the leaders of this country's steel industry are carrying out a liberal new construction program, reasons outlined in brief in the preceding paragraphs, furnish conclusive proof of the wisdom of their course. The skeptical bear is ruled out of order and the bull has the floor.

The actual increase in open hearth capacity during 1915 was 1,759,000 tons. As shown in the table on this page, the actual number of furnaces completed was 43. These figures compare with nine furnaces of 747,000 tons capacity completed in 1914 and 62 of 3,120,000 tons capacity completed in 1913. The increase was thus far below that in 1913, a year of active demand. However, conditions facing the steel industry in 1914 and 1916 are strikingly dissimilar, so that now there are 74 furnaces of 3,755,000 tons capacity under construction against only 40 of 1,830,000 tons capacity at the beginning of 1914. At the opening of 1915, there were 43 furnaces of 1,760,000 tons capacity under way; of this number, 37 were carried over from the previous year, due to the abandonment of building programs during 1914. On the other hand, of the 74 listed this year, only five were building a year ago. A detailed analysis published in *The Iron Trade Review* Dec. 31, 1914, gave the steel-producing capacity of the country as 37,500,000 tons. As shown earlier, capacity operations during the closing months of last year furnished ample verification of this estimate. The new capacity completed during the year added somewhat over one and one-half million tons, so that the country's capacity at the opening of 1915 can be conservatively set at 39,000,000 tons.

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Open Hearths Completed During 1915

	No. of furnaces.	Rated capacity, tons.	Estimated annual production, tons.
American Iron & Steel Mfg. Co.	4	50	125,000
Bethlehem Steel Co.	6	50	185,000
Brier Hill Steel Co.	1	85	60,000
Central Steel Co.	3	50	95,000
Corrigan, McKinney & Co.	8	75	400,000
Lackawanna Steel Co.	4	60	150,000
Lukens Iron & Steel Co.	1	50	30,000
Minnesota Steel Co.	7	75	350,000
Pittsburgh Crucible Steel Co.	2	60	75,000
Pittsburgh Iron & Steel Foundries	1	25	22,000
Republic Iron & Steel Co.	2	90	130,000
N. & G. Taylor Co.	1	25	22,000
Youngstown Iron & Steel Co.	3	60	115,000
	43		1,759,000

Open Hearths Building at End of 1915

	No. of furnaces.	Rated capacity, tons.	Estimated annual production, tons.
American Steel & Wire Co.	4	60	150,000
Bethlehem Steel Co.	8	100	600,000
Brier Hill Steel Co.	2	85	125,000
Carnegie Steel Co.	3	60	115,000
Central Steel Co.	4	50	120,000
*Illinois Steel Co.	2	100	240,000
Indiana Steel Co.	2	100	150,000
Inland Steel Co.	8	75	400,000
Interstate Iron & Steel Co.	2	60	75,000
Lackawanna Steel Co.	2	80	115,000
Lukens Iron & Steel Co.	6	75	300,000
Midvale Steel & Ordnance Co.	6	50	185,000
Minnesota Steel Co.	3	75	150,000
National Tube Co.	4	75	200,000
Pittsburgh Steel Co.	2	60	75,000
Standard Steel Car Co.	2	75	100,000
United Steel Co.	5	75	250,000
Wickwire Steel Co.	3	50	90,000
Alan Wood Iron & Steel Co.	3	50	90,000
Youngstown Sheet & Tube Co.	3	100	225,000
	74		3,755,000

*Furnaces will operate in connection with duplex process.

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Inland Steel Co.	8	75	400,000
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Lackawanna Steel Co.	2	80	115,000
Lukens Iron & Steel Co.	6	75	300,000
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Minnesota Steel Co.	3	75	150,000
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Electric Furnaces in United States and Canada

Heroult Furnaces

Company—Location.	Size of furnace, tons.	Basic or acid.	Current phase.	Product.*	Production, per year, tons.
Halcomb Steel Co., Syracuse, N. Y.	4	B	†	S. & T. S.	9,600
Halcomb Steel Co., Syracuse, N. Y.	6	B	3	S. & T. S.	7,200
Firth-Sterling Steel Co., McKeesport, Pa.	3	B	3	S. & T. S.	3,600
Illinois Steel Co., So. Chicago, Ill.	15	B	3	S. & R. S.	36,000
Illinois Steel Co., Joliet, Ill.	4	B	3	F. M.	3,600
Amer. Steel & Wire Co., Worcester, Mass.	15	B	3	W. S.	36,000
General Electric Co., Schenectady, N. Y.	5	B	3	C.	7,500
General Electric Co., Schenectady, N. Y.	3	B	3	C.	1,500
General Electric Co., Schenectady, N. Y.	3	B	3	C.	500
Treadwell Engineering Co., Easton, Pa.	2	B	3	C.	3,600
Nat'l Malleable Castings Co., Sharon, Pa.	6	B	3	C.	21,600
Nat'l Malleable Castings Co., Sharon, Pa.	6	B	3	C.	10,800
Nat'l Malleable Castings Co., Chicago	6	B	3	M. S. C.	18,000
Nat'l Malleable Castings Co., Chicago	6	B	3	M. S. C.	18,000
Nat'l Malleable Castings Co., Chicago	6	B	3	M. S. C.	18,000
Crucible Steel Co. of Amer., Harrison, N. J.	6	B	3	S. S.	14,400
Buchanan Elec. Steel Co., Buchanan, Mich.	2	B	3	C.	5,400
Buchanan Elec. Steel Co., Buchanan, Mich.	3	B	3	C.	3,600
Latrobe Electric Steel Co., Latrobe, Pa.	6	B	3	S. & T. S.	7,200
Latrobe Electric Steel Co., Latrobe, Pa.	3	B	3	S. & T. S.	4,500
United Steel Co., Canton, O.	6	B	3	S. S.	7,200
United Steel Co., Canton, O.	15	B	3	S. S.	18,000
Lebanon Steel Foundry Co., Lebanon, Pa.	1	B	3	C.	2,100
Elec. Steel Co. of Indiana, Indianapolis	3	B	3	C.	5,400
Amer. Steel Foundries, Indiana Harbor, Ind.	6	B	3	C.	9,000
Michigan Steel Castings Co., Detroit	6	B	3	C.	9,000
Michigan Steel Castings Co., Detroit	3	B	3	C.	5,400
Belle City Malleable Iron Co., Racine, Wis.	3	B	3	C.	5,400
Buckeye Steel Castings Co., Columbus, O.	6	B	3	C.	9,000
Simonds Mfg. Co., Lockport, N. Y.	6	B	3	S. T. & S. S.	7,200
Hess Steel Corporation, Baltimore	6	B	3	S. S.	7,200
Universal Rolling Mill Co., Bridgeville, Pa.	6	B	3	S. T. & S. S.	7,200
Carbon Steel Co., Pittsburgh	6	B	3	S. & A. S.	7,200
Braeburn Steel Co., Braeburn, Pa.	6	B	3	S. A. & T. S.	7,200
Crucible Steel Casting Co., Cleveland	1	B	3	S. C.	2,100
Monarch Foundry Co., Stockton, Cal.	1	B	3	S. C.	2,100
Harrow Spring Co., Kalamazoo, Mich.	6	B	3	S. & A. S.	7,200
Union Spring & Mfg. Co., New Kensington, Pa.	6	B	3	C.	9,000
International High Speed Steel Co., Rockaway, N. J.	6	B	3	S. & T. S.	5,000
Alabama Power Co., Anniston, Ala.	6	B	3	W. M.	9,000
Electric Steel & Metals, Ltd., Welland, Ont.	6	B	3	W. M.	9,000
Electric Steel & Metals, Ltd., Welland, Ont.	6	B	3	W. M.	9,000
Armstrong, Whitworth of Can., Longueuil, Q.	3	B	3	T. S.	3,600

Snyder Furnaces

Company—Location.	Capacity in 24 hours.
Crucible Steel Casting Co., Milwaukee, Wis.	12 tons
Otis Elevator Co., Buffalo	30 tons
Otis Elevator Co. (second furnace), Buffalo	30 tons
Niagara Electric Steel Corporation, North Tonawanda, N. Y.	6 tons
S. Fair & Son, Inc., Saginaw, Mich.	6 tons
Gerlinger Steel Casting Co., Milwaukee, Wis.	6 tons
Dayton Steel Foundry Co., Dayton, O.	12 tons
Halcomb Steel Co., Syracuse, N. Y.	30 tons
Sivyer Steel Casting Co., Milwaukee, Wis.	12 tons
Electric Steel Co., Chicago	12 tons
Haynes Stellite Co., Kokomo, Ind.	1½ tons
Thomas Davidson Mfg. Co., Montreal, Can.	12 tons
Canadian Brakeshoe Co., Sherbrooke, Canada	20 tons

Girod Furnaces

Simonds Mfg. Co., Lockport, N. Y.	½	†	Fine Steel.	525
Bethlehem Steel Co., So. Bethlehem, Pa.	10			10,500
Washington Iron Works, Seattle, Wash.	3			2,100
Elec. Steel Foundry Co., Portland, Ore.	.			

Gronwall Furnace

John A. Crowley Co., Detroit	5		A. S.	

Kjellin Furnace

General Electric Co., Pittsfield, Mass.	½	†		

G. S. F. Furnaces

Amer. Iron & Steel Mfg. Co., Lebanon, Pa.	20	†		
Amer. Iron & Steel Mfg. Co., Lebanon, Pa.	20	†		

Rennerfelt Furnaces

Old Dominion Iron & Nail Wks. Co., Richmond, Va.	.			
Old Dominion Iron & Nail Wks. Co., Richmond, Va.	.		S. C.	

*W. M. = War Material; T. S. = Tool Steel; S. & T. S. = Special and Tool Steel; S. & R. S. = Special and Rail Steel; F. M. = Ferro-manganese; W. S. = Wire Steel; C. = Castings; M. S. C. = Malleable Steel Castings; S. S. = Special Steels; S., T. & S. S. = Saw, Tool and Special Steel; S. & A. S. = Special and Alloy Steels; S., A. & T. S. = Special, Alloy and Tool Steels; S. C. = Steel Castings; A. S. = Alloy Steels.

†Single.

the following table, showing the capacities of the furnaces blown in from 1905 to 1915:

Year.	Gross tons.
1915	530,000
1914	None
1913	550,000
1912	1,000,000
1911	565,000
1910	1,794,000
1909	1,930,000
1908	1,188,000
1907	2,065,000
1906	1,135,000
1905	1,292,000

The estimate made last year of the pig iron producing capacity of the country was 35,000,000 tons. In November, however, with only one of the new 1915 furnaces in operation during the full month, the annual rate of production was 36,900,000 tons. Two factors must be considered before the estimated annual capacity of the country, as made last year, is found to be too low. Average production during one month does not indicate yearly capacity, as allowance must be made in all estimates for the percentage of furnaces out for relining. The majority of the big furnaces that aided in setting November's record, have been driven at capacity for months and some of them must be blown out shortly. In addition, the estimate of 35,000,000 tons was based on normal conditions. Last year, in referring to the estimated pig iron and steel producing capacity, it was stated that "these totals do not, of course, represent the ultimate capacity in a year of supernormal demand. That is, with prices boosted to the high figures of several decades ago, so that every steel-making unit and blast furnace in the country could and would operate at a profit; in such a case, these totals would be much too low." Such conditions have prevailed and, as a result, both estimates have been exceeded, the steel figure by a much smaller margin, as there were fewer old, scattered steel plants than blast furnaces.

The estimated pig iron capacity at the beginning of 1916 should take into consideration not only the new furnaces, but also those which have been rebuilt along modern lines. A conservative estimate, with all these various factors in mind, would indicate that under normal conditions the blast furnace capacity at this time is 36,000,000 tons, while the ultimate capacity under the most advantageous conditions would be a little more than 37,000,000 tons. The variance between this figure and the estimated steel-making capacity can be accounted for largely by the increased quantities of scrap being returned to the open hearth steel plants. In 1912, for instance, steel production exceeded that of pig iron by 1,525,000 tons. In addition, blast furnaces having a

capacity of 1,375,000 tons are being built or are authorized for early construction.

The furnaces completed last year included two by the Minnesota Steel Co., Duluth, Minn., and one by the Pennsylvania Steel Co., Steelton, Pa. All three were rated at 500 tons. Three furnaces with a capacity of 495,000 tons annually were under construction at the beginning of this year, comprising two for Corrigan, McKinney & Co., Cleveland, and one for the United Furnace Co., Canton, O.

Five furnaces, all of 500 tons capacity, have been authorized; two by the Indiana Steel Co., and one each by the Midvale Steel & Ordnance Co., Republic Iron & Steel Co. and Youngstown Sheet & Tube Co. Their estimated annual capacity is 880,000 tons. In addition, plans are being considered for nine additional furnaces, of about 1,485,000 tons capacity. These comprise three for the Bethlehem Steel Co., two for the Indiana Steel Co. and one each by the Donner Steel Co., Midvale Steel & Ordnance Co., Inland Steel Co. and Sloss-Sheffield Steel & Iron Co. The Donner Steel Co. expects to build a second furnace at a later date. The electric steel-making industry in the United States showed a remarkable expansion in 1915. The number and capacity of the furnaces in operation or being installed, increased more than 100 per cent. The large number of companies engaged in various lines of manufacture, which already have adopted this process or are seriously considering doing so, points to a significant movement of permanent character in the production of high-grade steel in this country. The electric steel-making capacity of the country, either built or under construction at the present time, is estimated at 450,000 tons annually. A year ago, it was less than 200,000 tons. The number of Heroult furnaces alone increased during the year from 18 to 40, and the estimated output from 141,200 tons to 372,500 tons annually.

The development of the manufacture of high-quality steels in electric furnaces in the United States is following the trend in evidence in Europe since about 1905. Active market conditions coupled with influences incident to, but not directly caused by the war, have greatly stimulated this advancement during the past year. Few of the new furnaces were installed primarily to make munition steel. The overwhelming majority will produce alloy and special carbon steel, and steel for small castings. A number of plants, which previously made steel by the crucible process, have discarded that method in favor of the electric furnace, 10 companies making the change during the year. Imports of alloy and special carbon steels to this country, especially from Germany, having been shut off by the war, consumers in searching for substitutes found that electric steels met their requirements.

Tonnage manufacture of electric steel in the United States in such lines as rails, and other heavy products, is increasing annually. The American Iron & Steel Mfg. Co., Lebanon, Pa., has the largest electric furnace installation in the world. The record of installations given in the accompanying table shows that the movement during the past year was largely to obtain steel for special purposes. The table furnishes a complete list of the Snyder, Heroult and Girod furnaces operating or being installed at the opening of 1916.

Wire Company Completes Zinc Plant

THE American Steel & Wire Co. is completing a plant for the reduction of zinc ore and the manufacture of sulphuric acid at Donora, Pa. The zinc smelting departments have been in operation for some time and the plant commenced to make sulphuric acid during the week of Dec. 20. The Steel & Wire company's main reason for building this plant was to insure a supply of spelter at all times for its own consumption at a fixed cost, that would be independent of the wide fluctuations that occur constantly in the open market. The American Steel & Wire Co. will not use the entire output of the Donora plant, and the remainder will be sold to the American Sheet & Tin Plate Co., National Tube Co. and other subsidiaries of the Steel Corporation, which are consumers of zinc.

When the entire plant is completed, it will contain 10 furnaces with an output of 40,000 tons of spelter and about 100,000 tons commercial sulphuric acid per year. Four furnaces now are operating. It is expected that the wire company will use half or more of the 40,000 tons when the maximum output is reached.

Plans for the proposed plant were drawn by engineers of the American Steel & Wire Co., and some notable records were made for rapid construction.

The first excavating was done on June 22, 1915, and the first zinc was turned out on Oct. 20, 1915, just 104 days from the day the work was first started. The acid plant is known as a three-unit plant, each plant comprising a tower building, an acid chamber building and two roasting furnaces. A site of 40 acres was selected between the Monongahela division of the Pennsylvania railroad and the Monongahela river. It is located immediately adjacent to the wire and rod mills of the American Steel & Wire Co. at Donora.

Ores Received in Bond

The coal for the plant is raised on the coal hoist at the open hearth steel works of the wire mills and is transported into the plant in steel hopper cars. All the ores are received on the Monongahela division of the Pennsylvania railroad, those now used being carbonates from the western states. It is the ultimate intention also to use sulphide ores from Montana and Australia. The Australian ores will be received at Donora in closed box cars, shipped in bond. The roasting furnaces are 20 x 80 feet, with modern improvements. The furnaces are double, seven hearths high, each hearth 26 x 20 feet, making 6,800 square feet of hearth area to each furnace.

The sulphuric acid department is contained in two buildings, both of steel and fire brick tile construction. The tower building is 71 feet wide, by 150 feet long, and the chamber building is 138 feet wide by 440 feet long. The roasting furnace gases on leaving the furnaces pass through a centrifugal gas chamber 30 feet high and 20 feet in diameter.

There are ten spelter furnaces, each containing 912 retorts, 8 inches inside diameter. The smelting capacity of each furnace is 10 tons per 24 hours. The spelter furnace building is of all-steel construction, covered with asbestos protected corrugated metal. Over each furnace has been constructed a steel canopy to prevent draughts of air freezing the liquid zinc in the condensers. The waste gases from the furnace pass through a 588-horsepower vertical water tube boiler, which is equipped with a superheater and thence to a tapering reinforced concrete stack 125 feet high, with an inside diameter of 5 feet at the top.

December Iron Output Sets Record

LAST YEAR will always rank as one of the most unusual in American pig iron history. Opening with the number of active furnaces at the lowest level in years, it closed with last month establishing a new high water mark in pig iron production. No stronger demonstration of the marvelous recuperative powers of the iron and steel industry in meeting an unexpected and unprecedented demand, could be afforded.

BY SETTING a new high record in the monthly output of pig iron, December gave a characteristically 1915 ending to a year of striking changes in pig iron production. The output of coke and anthracite pig iron last month was 3,200,638 tons, or more than 80,000 tons above the previous mark set in October. The total production of pig iron in 1915 was 29,572,194 tons, exceeding 1914 by more than 6,500,000 tons, but a million tons less than the record established in 1913.

MONTHLY PRODUCTION.

	1915.	1914.	1913.
January	1,591,024	1,879,336	2,787,800
February ..	1,666,592	1,888,607	2,578,670
March	2,046,280	2,341,551	2,762,823
April	2,114,518	2,261,501	2,754,353
May	2,255,157	2,097,019	2,816,825
June	2,369,932	1,904,566	2,616,883
Total 1st half	12,043,503	12,372,580	16,317,354
July	2,563,311	1,955,324	2,558,275
August	2,774,825	1,996,483	2,537,018
September ..	2,834,342	1,882,718	2,494,098
October	3,120,340	1,767,227	2,539,924
November ..	3,035,235	1,501,269	2,229,960
December ..	3,200,638	1,495,325	1,976,138
Total 2d half	17,528,691	10,598,346	14,335,413
Grand total	29,572,194	22,970,926	30,652,767

A comprehensive survey of the wonderful recovery of the blast furnace industry last year, is afforded by a comparison of the closing months of 1915 and 1914. The production of 3,200,638 tons in December, 1915, compares with 1,495,325 tons in December, 1914. The stacks in blast on the closing days of the two years were 295 and 154, respectively. The average daily output last month was 103,246 tons, against 48,236 tons in December, 1914.

The production of pig iron during the second half of 1915 was 17,528,691 tons, a new high record. During the first six months of the year, the output was only 12,043,503 tons. The capacity of the stacks in blast on Dec. 31 was 38,400,000 tons annually.

Merchant Furnaces Gain

December's production shows a gain of 165,403 tons over November with an output of 3,035,235 tons. The December average daily production broke the record set in November at 101,174 tons, by 2,072 tons. Comparatively, the merchant furnaces made the larger gain during the month. The merchant furnaces produced 860,524 tons in December for a daily average of 27,759 tons, against a total of 789,864 tons in November, when their daily average was 26,329 tons. The gain in merchant iron output was thus 70,660 tons, and in daily average production was 1,430 tons. The steel works or non-merchant furnaces produced 2,314,896 tons in December, a gain of 98,397 tons over November with 2,216,499 tons. The daily average production of non-merchant iron last month was 74,674 tons against 73,883 tons in November, a gain of 791 tons.

The number of active stacks continues to mount, and reached 295 on Dec. 31, a gain of 10 over November. This is the greatest number in blast since April, 1913, and has been exceeded by only three months since March, 1910. The merchant interests are largely responsible for last month's gain, nine merchant furnaces being relighted and one being blown out, a net gain of eight. Three steel works furnaces were blown in and one blown out, a net gain of two.

The output of ferro last month was 17,599 tons against 18,678 tons in November, a loss of 1,079 tons. Spiegel production in December was 7,619 tons, against 10,194 tons in November, a loss of 2,575 tons.

AVERAGE DAILY PRODUCTION.

	1915.	1914.	1913.	1912.
January	51,323	60,624	89,929	66,220
February	59,521	67,450	92,095	72,372
March	66,009	75,534	89,123	77,791
Apr.	70,484	75,383	91,812	79,254
May	72,747	67,646	90,865	80,753
June	78,998	63,486	87,229	81,125
July	82,687	63,075	82,525	77,502
August	89,510	64,403	81,839	80,650
September	94,478	62,757	83,137	81,482
October	100,656	57,007	81,933	86,569
Nov.	101,174	50,042	74,322	87,985
December	103,246	48,236	63,746	89,590
Average	81,020	62,934	83,980	80,124

The merchant furnaces blown in last month were: Federal "B", Federal Furnace Co., Dec. 4; one Hubbard, Andrews & Hitchcock Iron Co., Dec. 28; one Buckeye, Columbus Iron & Steel Co.; Topton, Empire Steel & Iron Co., Dec. 8; Bird Coleman No. 4, Lackawanna Iron & Steel Co., Dec. 19; Crumwold, Reading Iron Co., Dec. 15; Sharpsville, Allen S. Davison Co., Dec. 1; Chattanooga, Chattanooga Iron & Coal Co., Dec. 4, and Standard, Standard Iron Co. Alice, of the Valley Mold & Iron Co., was damaged in an accident on Dec. 11.

The steel works furnaces blown in were: Joliet No. 3, Illinois Steel Co., Dec. 15; Nellie B, Donner Steel Co., Dec. 31, and Steelton No. 2, Pennsylvania Steel Co., Dec. 12. South Works furnace No. 7 of the Illinois Steel Co., was blown out Dec. 24.

Sharon furnace of the Carnegie Steel Co. was blown out Jan. 1 for relining. Marshall furnace of the Juniata Furnace & Foundry Co., will be blown in about Jan. 15. The Watts, Kentucky, furnaces of the Virginia Iron, Coal & Coke Co., are being repaired and one will resume about Feb. 1.

DECEMBER PIG IRON.

States	No. of stacks	No. in blast last day of month. Dec.	Nov.	Total tonnage made. Merchant.	Non-Merchant.	Totals— Dec.	Nov.
Pennsylvania	155	123	119	242,587	1,116,141	1,358,728	1,302,140
Ohio	73	61	59	186,628	517,869	704,497	678,297
Alabama	45	26	26	167,506	57,748	225,254	208,864
Virginia	22	7	7	29,984	.....	29,984	28,913
New York	26	19	18	88,036	105,331	193,367	186,872
New Jersey	6	1	1	5,169	.....	5,169	6,022
Illinois	26	21	20	41,218	271,321	312,539	286,233
Colorado	6	2	2				
Indiana	10	10	10	34,988	209,937	244,925	221,937
Maryland	4	3	3				
Wisconsin	6	5	5				
Kentucky	7	3	3				
West Virginia.....	4	3	3	35,342	27,155	62,497	58,070
Tennessee	18	7	5				
Washington	1	0	0				
Georgia	2	0	0				
Texas	3	0	0				
Minnesota	3	2	2	29,066	9,394	38,460	29,015
Michigan.....	3	2	2				
Missouri	1	0	0				
Spiegel—All states..						7,619	10,194
Ferro—All states...						17,599	18,678
Totals	421	295	285	860,524	2,314,896	3,200,638	3,035,235

Making Chain Under Steam Hammers

By F. G. Coburn
Naval Constructor, U. S. N.

Hand-Welded 3-inch Chain Which Failed in Test. Chain is Irregular in shape and size

Hammer-Welded 3-inch Chain Which Broke Well Above Required Pull. Chain is uniform in shape and size

CHAIN CABLES for vessels of the United States navy are now being manufactured at the Boston navy yard under steam hammers. The process has been developed to a point where its success as a rapid and high-grade producer is unquestionable. For many years, all chain cables for naval vessels of all kinds and sizes were made at the Boston yard, with only an occasional purchase of chain under exceptional conditions. Until comparatively recently, the old-fashioned methods of chain-making were accepted and followed; but about five or six years ago a movement was begun to improve these old methods. The trade of hand-chain-making is a fairly old one, and as the industry is not large, the trade has not received much attention. The chain fires look much as they did a hundred years ago; and the chain-makers go through the same motions that their great-great-grandfathers did. Machine processes of manufacturing small chain have been invented, and are in actual use; but the quality of the product is not always equal to that of the hand-welded product—and the latter is by no means perfect. In the hand process, the scarf is formed by peening, with the back of the sledge; this results in a rough, irregular faying surface, frequently with fairly large pockets. These pockets retain slag, and the unevenness of the faying surfaces brings about a separation of the surfaces which is not reduced by the hammering during welding, particularly in the large sizes. The result is that the weld is not complete; and the danger lies in this, that the edges of the scarfs are perfectly welded and smoothly finished, completely masking the bad weld. The writer has seen a link of old chain break in the test pit—chain that had been in service for several years—the break occurring along the scarf and showing both slag pockets and sledge marks. It was perfectly welded around the edges, but the inside, probably 75 per cent of the faying surface, was absolutely not welded at all. The link had never parted in service, because end-welded chain has a high measure of strength due to its form, and the additional strength, due to the welded area, was sufficient to make it stand the stresses of service, which, fortunately, were not high. Hand-welded chain is usually irregular in shape and dimensions, an important deficiency if the chain is to be veered and hove over a wild cat. Hand welders are a bit careless in this respect, as a rule, but when impressed with the necessity of uniformity and equipped with gages it must be said for them that they will turn out very uniform chain. But whatever may be the comparative advantages and disadvantages existing between hand-welded and machine-welded chain in the small sizes, there is no question at all about the shortcomings of the hand process when applied to large chain. Large chain may be defined as chain of 2¼ inches diameter and upward. The hand welders do fairly well up to 2½ inches, although there are plants which make hard work of anything over 2 inches; above these sizes they run into difficulties. At the Boston yard, by dint of close attention to inspection and tests, no great difficulty was had, until the 2⅞-inch and 3-inch sizes were reached, in the gradual increase of chain sizes, which accompanied battleship development. This 3-inch chain is so large that the hand welders made very hard work of it. In addition, they were actually unable to make the scarfs come together truly, and could not, on account of the limitations of their tools, make a fair, round section at the weld. Finally, the problem of making the 3¼-inch cables for the battleship Pennsylvania was faced. When the iron for these cables was delivered, two sample triplets were made for testing, one triplet by one gang, the other by another gang. Each gang took a whole day to make its three links, and then stayed out all the next day to rest from its arduous labor. One and one-half links per gang per day. At that rate it would have taken one gang more than seven years to make that one set of cables. With all the capacity available in the shop for large chain work concentrated on that one order, it would have required more than a year. With the steam hammers, one gang produces 20 links of this size chain per day, every day. There seems to be no need for argument as to the advisability of going to the use of the hammers. Cost would be no consideration, because the chain must be made,

and in reasonable time; fortunately, however, the cost is lower for hammer-forged chain. The same requirements as to quality are imposed for hammer-welded chain as for hand-welded chain; and actually are surpassed. The chain is uniform; all links are of the same size, a very important matter, as battleship cables are hove over wild cats which grip only a few links. The breaking stress is in excess of requirements. On some 3-inch chain, open link—that is, without studs—the test triplets from the hand welders' work broke, on the average, at about 485,000 pounds; the test of hammer-welded chain averaged about 525,000 pounds. In every way, quantity, quality and cost, the hammer welding process has proved superior to the hand method. In this process, the bar iron is sheared up into bolts, each bolt long enough to make one link. Each bolt is then scarfed at both ends, each scarf requiring three operations. The first operation, done in an upsetting machine, puts in a right-angled bend and at the same time slightly upsets the metal.

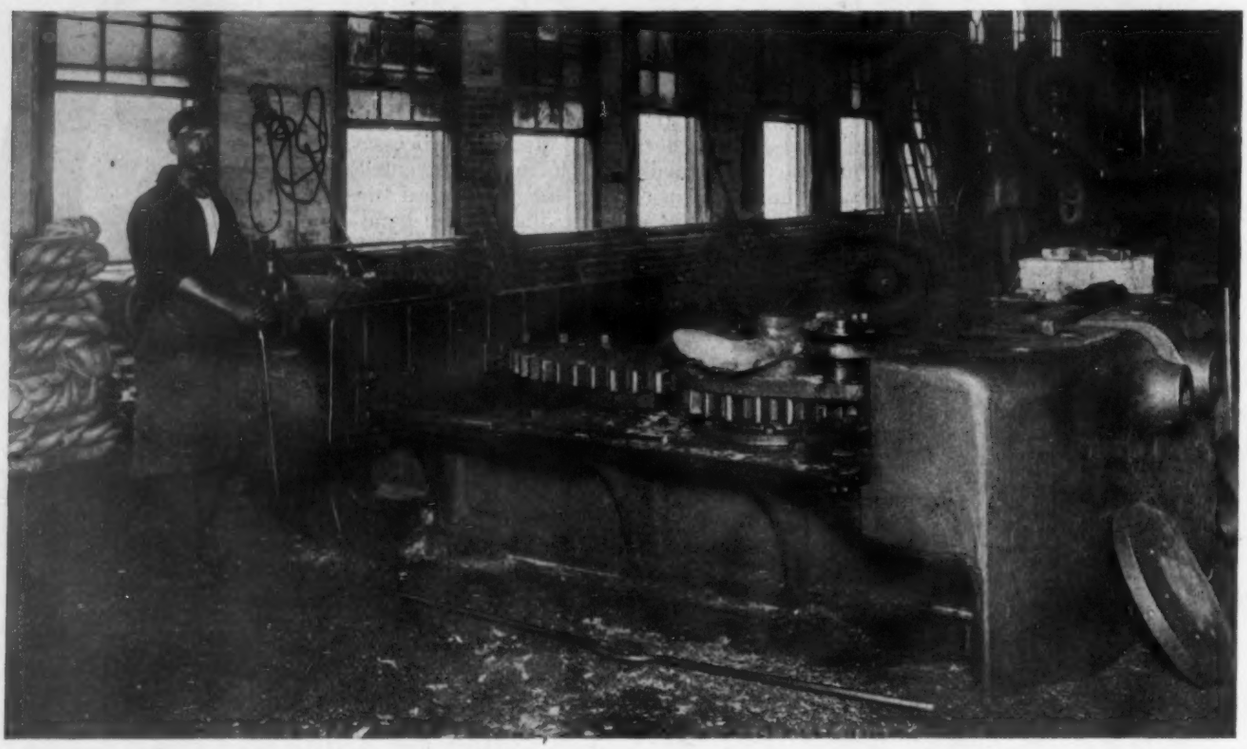
The second operation, done in a steam drop hammer in the same heat, shapes the metal into a scarf. The third operation trims off the flash. When the two ends are thus treated, it is only necessary to bend the bolt into an approximate U-shape, whereupon the right angle bend of the scarf brings the two scarfs close together. This bending operation was first done by hand, as by the old hand methods, but is now done in a hydraulic bulldozer. The mandrel around which the scarfed bolt is to be warped, is stationary. A collar around its base, carries a stud on which is mounted a flanged wheel. The outside of the collar is toothed, gearing with a toothed sector which is linked to the ram of the bulldozer. Thus when the ram comes forward, the collar is rotated around the mandrel, and therefore the little flanged wheel, carried on this collar, is moved around likewise, wrapping the bolt around the mandrel. Then the scarfs are pried apart by a crow bar, that the link may be threaded into the last one made. The scarfing and bending operations are very short, so a stock of each size in process is maintained for the welders. To avoid the necessity for the welder to start each weld with a cold link, a pre-heating furnace is provided, from which the welder gets his bent links for welding.

The welding process is performed in two heats. Each welding plant is composed of an 1,800-pound steam drop hammer, with a 250-pound single frame forging hammer on each side, thus employing two gangs. The two gangs divide the drop hammers between them, but each has its own 250-pound hammer, fire and crane.

The details of the cranes, hoists and dies, and their relative locations, are the result of many months of experimental work. At first, the dies were built to suit wooden models of the links, and every decision was made by rule of thumb. But after making the process a success, and before going too far with the construction of the dies, the work was put on an engineering basis, and could now be put in a hand book. Recently the designs for the dies for 3⅜-inch chain were completed in the drafting room and sent into the shops; the dies were made and set up in their respective machines; and from the start the new chain was successful.

Briefly, the process of welding is as follows. A preheated link is threaded through the last link made, and the scarfs pushed together by the dies in the 1,800-pound hammer. The dies of both hammers, and the center of the oil forge, being on the arc of the crane, the new link is swung over to the forge and lowered into the heating chamber. When at welding heat, it is taken out and over to the 250-pound hammer, where it is hammered between the horns of the dies. This operation does the major part of the welding.

The link is swung back to the fire for a second welding heat, when it is taken to the forming dies, in the 1,800-pound hammer. There the tips of the scarfs are thoroughly welded, and the link exactly formed, all in a few blows. After trimming off the



BENDING BOLTS FOR MAKING LINKS

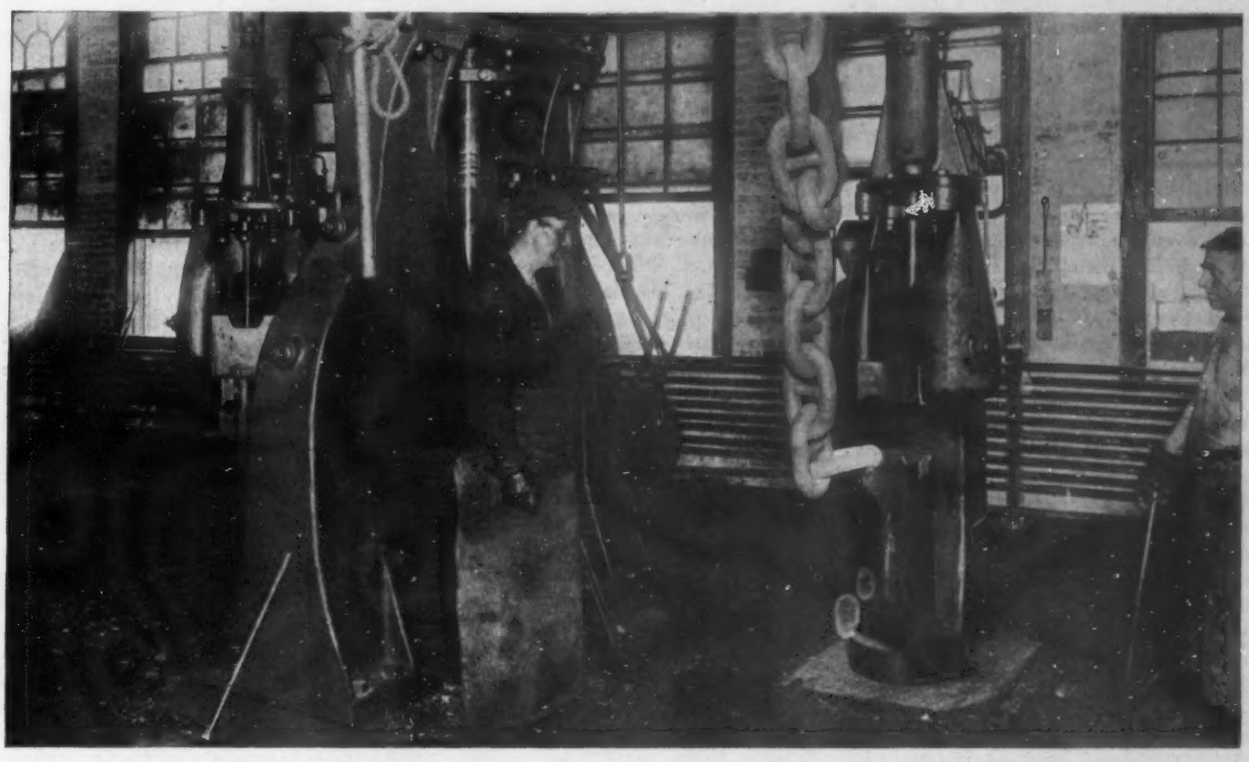
flash and setting the stud in place, the link is closed down on the stud and the operation is complete.

When the hammer welding process was taken up actively for development, about one and one-half years ago, the process was essentially what it is today. The chain produced was to all appearances perfectly good, but it failed in tensile test, always falling short of the required ultimate break, and exhibiting a rather coarse granular structure in the fracture. The possibility of the oil fire being the cause was eliminated by the fact that coke fire welds behaved the same way. Alterations to the dies were made but although they were sensible alterations and improvements, the quality of the chain did not improve. Even the theory that practice makes perfect did not apply; it was thoroughly tested, too.

Heat treatment was thought of, but not very seriously at first. There was no equipment for exact methods of heat treatment, nor was there experience for guidance in attacking the problem. But finally, a test triplet of 3-inch chain was one day heated to what looked to be about 2,000 degrees Fahr. and cooled in air, just as a venture. It tested well above the specified requirements, and then, of course, the solution of the problem was a matter of detail.

The completed chain is heat treated in a car bottom fuel oil furnace about 6 feet wide and 30 feet long. It is of the overfired type, fitted with 16 burners, eight on each side. When heat treating chain, it is brought up as rapidly as practicable to about 900 degrees Cent., and held at that temperature until the charge is ready to come out. The regulation is comparatively close, the limit of variation being about 15 degrees at any one thermocouple or between couples in different parts of the furnace. There are eight couples in the furnace, four on each side; and the temperature of the iron is measured by a ninth couple, the hot junction of which is inserted in a piece of iron of the same diameter as the chain under treatment. This piece is laid on the car beneath the chain. The couples are of iron and constantan wire. The cold junctions of all couples are led by wires of the same metals to a box in the furnace booth, where the cold junction temperature is measured by thermometer, and allowed for. All temperature measurements are by potentiometer, the galvanometric method not being considered sufficiently accurate. The accuracy aimed at allows a maximum error of 10 degrees Cent., which at 1,000 degrees Cent. is about 1 per cent; but the accuracy actually obtained is somewhat better than that.

The action of the heat treatment is to reduce the brittleness, and coarseness of grain structure, making the iron ductile enough to yield to shearing stresses, yet tough enough to be high in tensile strength. Stiffness must be avoided, as the close-grained, rigid structure desirable in a structural forging, does not answer in chain. The distribution of forces in the link is such that in the quarters there are maximums of shearing stress. These shearing stresses build up very rapidly, and unless the metal is ductile enough to yield to them, the link will shear off sharply, at a low total longitudinal pull, because, of course, iron is much weaker in shear than in tension. Stiffness promotes failure in shear; reasonable ductility combined with reasonable toughness promotes failure in tension. This was the hypothesis first evolved, and experiments warranted considering it a theory, especially as more exact methods of heat treatment became available and concordant test results could be obtained.



LARGE STEAM DROP HAMMER AND SINGLE FRAME FORGING HAMMER

It is necessary to explain why the hammer-welded link must have heat treatment, while the hand-welded link does very well without it. The hammer-welded link has a long scarf, reaching well around to the quarters. Both in the scarfing and in the welding operations, the metal is thoroughly hammered; in the latter operation being hammered while cooling from welding temperature down through the critical range. As the scarf is long, this hammering reaches around into

the region where the shearing stresses are found. The hand welder, however, makes the scarf just as short as he can; the shorter it is, the less work for his helpers. The result is that less of the metal is severely worked, and that the working does not extend into the region of high shearing stresses. Therefore this region is not stiffened up enough to require subsequent heat treatment.

As might be expected, the hammer-welded link after it has been heat treated, is a better link than the hand-welded link: it is a better job mechanically, and has a better and more uniform grain structure.

A natural concomitant of the application of power machinery to a process previously done by hand was the division of labor. No longer does the chainmaker scarf and bend and weld; one gang now scarfs, another bends, and a third does the welding. The last operation is very skilled work, and the workmen who do it are earning bigger wages than were the chainmakers before. The work of scarfing and bending does not require skilled labor, and those workmen who do it earn less than the chainmakers did.

The total cost of the chain is less than before, but on the other hand, the workmen engaged in the process are earning more than they did before, because the lower priced work is being done by men who were helpers previously, but have been trained to these special jobs. On the whole, therefore, costs are lower, earnings are higher, production greater, and quality better than ever before. The process is an economic, as well as an engineering development.

Pittsburgh Makes Its Greatest Record

(Continued from Page 31)

the United Furnace Co.; 94 for the LaBelle Iron Works; 94 for the Toledo Furnace Co.; 92 for the Minnesota Steel Co., and 212 for the Bethlehem Steel Co. Several of these concerns were operating by-product coke oven plants previous to Jan. 1, 1915. While no official announcement has been made, the United States Steel Corporation probably will build additional batteries of retort ovens in the near future.

The increase in the production of retort oven coke seriously has affected demand for beehive oven fuel. This does not mean, however, that the future holds nothing in store for Connellsville operators; there will be an active market for beehive ovens coke and, after the period of reconstruction is passed, standard grades of beehive coke probably will command more uniform and higher prices than those obtained the last five years.

Production of Connellsville fuel in 1915 will not amount to more than 17,225,000 tons, compared with 14,075,638 tons in 1914, 20,097,901 tons in 1913, 20,000,875 tons in 1912 and 16,334,174 tons in 1911. In 1911, the average price of blast furnace coke for prompt shipment was $1.48; in 1912, $2.55; in 1913, $2.34; in 1914, $1.75, and in 1915, $1.78 a ton at the ovens. The average price of foundry coke for prompt delivery in 1911, was $1.89; in 1912, $2.90; in 1913, $3.06; in 1914, $2.29, and in 1915, $2.40 a ton at the ovens.

The chart published as a supplement to this issue shows the trend of prompt furnace coke prices the last 16 years. It will be noted that during the period outlined, furnace coke has sold at a spread from $1.40, recorded in 1904, to $5 a ton; the maximum figure was obtained in 1902. The bulk of the fuel for blast furnace consumption in 1915 was sold at a range from $1.65 to $1.95 a ton; foundry coke sold at a spread from $2.25 to $2.60, ovens, for contract delivery. Not once during the first nine months of 1915 did weekly production of Connellsville coke reach the 400,000-ton mark; production since the week ending Oct. 9 has been above that figure.

The bulk of the coke sold for 1916 shipment was obtained through sliding scale contracts, based upon the selling price of basic pig iron. Some fuel was sold at $2.25, ovens, for 12 months' delivery. The price of spot 48-hour coke jumped to $3.50, ovens, the third week of December, and some foundry coke was sold at $4, ovens, for immediate shipment.

A scarcity of labor has existed in the coke regions of western Pennsylvania for eight or nine months. A decided increase in demand for fuel probably would send prices skyrocketing, since maximum weekly production is now estimated at about 450,000 tons.

Labor Conditions

Despite alleged activities of foreign agents accused of causing unrest in the ranks of machine shop and mill employes throughout the country, the general labor situation in the Greater Pittsburgh district in 1915 was satisfactory. Strikes occurred at several plants in Wheeling, Connellsville and Pittsburgh districts, but no unusual labor difficulties were experienced. Iron molders employed in foundries at Pittsburgh went on a strike Dec. 13, demanding an 8-hour day with pay for a 9-hour day. Requests for an 8-hour day were rather general throughout districts in which machinists are employed.

At a third referendum held in March, sheet and tin plate mill divisions of the Amalgamated Association of Iron, Steel and Tin Workers voted to accept revised wage schedules providing reductions of about 11.2 per cent for sheet mill and 6 per cent for tin plate mill men. Because of the prolonged business depression, the American Sheet & Tin Plate Co. adopted revised wage schedules in its mills several weeks after reductions had been made in independent plants. Reduced wage schedules were accepted by the Amalgamated Association when sheet and tin mill wages for the year beginning July 1, 1915, were arranged. The bar iron mill scale of the Amalgamated Association for the year beginning July 1, 1915, is practically the same as that for the preceeding year, except that a separate classification is provided for jobbing mills having no heating furnaces.

Independent coke makers in the Connellsville regions reduced wages the early part of the year, but the H. C. Frick Co. scale, regarded as a standard, was re-adopted shortly after July 1. Thousands of foreigners employed in the coke regions, the mines and mills of western Pennsylvania, eastern Ohio and West Virginia returned to Europe to take part in the war. Government employment bureaus reported that there were very few idle men in the Greater Pittsburgh district at the end of the year.

A soft wheel at the proper speed will give more satisfactory results than a harder wheel at slower speed. Don't forget that the wheel maker has had a wide experience and is always willing to give you the benefit of it.

Drills should be examined and, if necessary, ground every time they come back into the toolroom. Sharp drills save time and do better work.

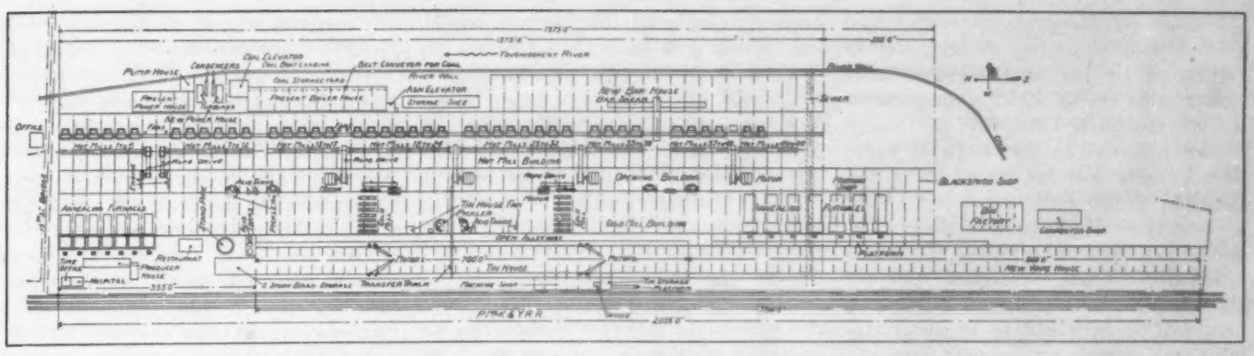


Fig. 1—Arrangement of Plant, McKeesport Tin Plate Co., McKeesport, Pa.

Largest Tin Plate Plant in World

WHEN the 20-mill extension to its present facilities is completed, the McKeesport Tin Plate Co., McKeesport, Pa., will command 42 mills, capable of producing 4,000,000 base boxes of tin plate per year. It is planned to operate the entire equipment by means of electric power. A complete description of this interesting plant, including the layout and arrangement of machines is given in the accompanying article.

By C. F. Williams

THE largest single tin plate manufacturing plant in the world will be operated by the McKeesport Tin Plate Co., McKeesport, Pa., when that company's 20-mill extension, now under course of construction, is completed. The remodeled plant will contain 42 mills, or 10 more mills, it is claimed, than the next largest tin plate plant in the country. The extension, which will be completed during the second quarter of this year, will give the company a total annual capacity of 4,000,000 base boxes of tin plate, or double the output of the mill now in operation. The company's plant is situated on the west bank of the Youghiogheny river at Port Vue, Pa., a few miles from the center of McKeesport. To provide for the increase in capacity, it was necessary to extend the main mill building 650 feet in length, a number of new buildings, including a bar house, boiler house, as well as severel auxiliary buildings, now being under construction. The general layout of the present plant will be changed but slightly, since the extension was contemplated when the plant was enlarged in 1909. New equipment will be installed and some of the present equipment will be remodeled, without causing the cessation of operations in any of the various departments. The present main mill building contains 29 bays, each 25 feet in width, and the addition will contain 26 bays of similar width. Fig. 1 shows the general arrangement of the old and new buildings, the latter extending south from the motor-driven hot mill stands, from Nos. 26 to 32, as illustrated. The various departments of the enlarged plant will be arranged to permit the

FIG. 2—SHEET AND PAIR FURNACES IN HOT MILL BUILDING, WHICH IS BEING REMODELED TO MAKE ROOM FOR OVERHEAD CRANE

minimum handling of material. The receipt and shipment of material is facilitated by the advantageous location of side tracks which connect with the Pittsburgh & Lake Erie railroad.

Raw material, in the shape of sheet or tin bars, will be stored in a bar shed, 65 x 650 feet, which will have a capacity of 25,000 tons of sheet bars, and which will be equipped with two automatic shears, designed to cut eight bars at one stroke. The sheared bars will be delivered to an automatic table, which will carry them into the furnace building, where they will be weighed for distribution to the furnaces. The furnace building is to be 43 feet wide and 1,375 feet long, and will house 42 sheet and pair furnaces, 40 of which will be of standard Hagan design. Two of the furnaces will be used for extra wide plates. The pair

FIG. 3—HOT MILL BUILDING SHOWING SHEAR AND OTHER EQUIPMENT

heating compartments of the old and new standard furnaces are 5 feet 3 inches long and 9 feet 3 inches wide and the sheet heating compartments are 8 feet 3 inches long and 9 feet 3 inches wide. The large furnaces for pair heating will have compartments 9 feet 3 inches square. The sheet heating furnaces will have two double compartments each, 5 feet 9 inches long and 9 feet 3 inches wide. Fig. 2 shows the old sheet and pair furnaces, which are being remodeled. The contract for the furnace equipment was awarded to the George J. Hagan Co., Pittsburgh. Eighteen of the furnaces will be located in the new addition, provision having been made for two additional furnaces, if required.

From the furnace building, the heated bars will pass in logical sequence to mills in the hot mill building, which will be 60 x 1,375 feet in dimensions. This building will contain 42 28-inch hot mills of a heavy type. The present building will house 24 of the mills, as shown in Fig 3, and the remaining 18 mills will be located in the addition. Twelve of the mills now driven by engines built by the Mesta Machine Co., Pittsburgh, will not be changed in position. The 10 original mills will be arranged with the new mills to provide three trains of eight mills each and one train of six mills. Each of the four trains will be rope driven by a 1,600 horsepower General Electric motor, through a driving stand connected to the motor. The drive stand will be equipped with a heavy flywheel. Foundations for the six-mill train will be designed to house two additional stands. All of the mills in the plant were designed by the United Engineering & Foundry Co., Pittsburgh, which also received the contracts for the doubling shears, squaring shears and bar shears. The hot mill building will be served by four electric cranes, each of 20 tons capacity.

New Opening Building

From the hot mill building, the material will pass to the new opening building which will contain 42 squaring shears, knife grinders, roll polishers and other necessary equipment. This building will be 40 x 1,575 feet in size and will be commanded by three 10-ton cranes. After the packs have been opened, the material will be trucked to four picklers. Two of the picklers have been in use for several years. All of them will be of the four-arm self-supporting type, built by the Mesta Machine Co., Pittsburgh.

After leaving the opening department, the material will be transported to the cold mill building, which will be 75 x 1,575 feet in dimensions. Fourteen annealing furnaces, built in 1909, are situated at the extreme north end of the building, as shown in Fig. 4; and 14 new annealing furnaces are being built at the opposite end of the structure by the Hagan company. The furnaces in the new battery will be considerably larger than those erected six years ago. The floor space occupied by one battery of two new furnaces, will be 23 x 36 feet. All of these furnaces are of the flexible type, fitted for either natural or coke oven gas, and with stoker-fired equipment. Stokers will be used for an indefinite period. The old furnaces in this department are being equipped with stokers to take the place of producer gas.

The plates will be distributed from the ovens to two cold mills, each containing 21 stands of 26-inch rolls, arranged in triple tandem, and driven by a 750-horsepower motor. The new mills are being built by the United Engineering & Foundry Co. The motors, which will be furnished by the General Electric Co., are to be connected through rope drives to the cold mill gear stands, there being 26 2-inch ropes to each mill. After passing through the cold mills, the plates will be carried to two picklers, of the three-arm self-supporting type, located in the center of the cold mill building. Acid is to be piped to the picklers from the tin house by compressed air. Electrically-operated

transfer buggies will carry material from the white picklers to the tin house, which will be served by four 15-ton cranes.

Tin House and Warehouse

The tin house and the warehouse will be located in one building, 1,700 feet in length; this building will have a width of 66 feet at the tin house end and a width of 50 feet at the warehouse end. The two departments will be served by five 5-ton overhead traveling cranes. The tin house will contain 75 tin settings, for coating all the black plate manufactured. The tinning pots will be gas fired and the tinning rolls will be driven by motors and line shafting. The cleaning machines will be motor driven. The house for bran and other cleaning materials are to be located at the south end of the tin house. Pig tin will be stored in a brick building, 25 x 50 feet in size. Palm oil will be stored between the cold mill building and the tin house.

The material, after being sorted and packed, will be carried to the warehouse by means of an overhead traveling crane. A shipping platform is designed to extend for the full length of the warehouse building, and shipping tracks will run along both sides of the warehouse.

Details of Box Factory

The box factory, which will be located at one end of the cold mill building, will be a two-story structure, 62 x 110 feet in dimensions. Boxes will be made on the ground floor, while the second floor, which will have a capacity of 150,000 boxes, will be used for storage purposes. The boxes will be delivered to the warehouse either by storage battery trucks or by automatic conveying machinery.

All of the new mills, as well as 10 of the old ones, are being laid out for electric drive, and it is planned eventually to operate the entire plant by electric power. Two power houses, one for direct current and the other for alternating current production, are located immediately adjacent to the river wall. The former building, built in 1909, contains two units of 300 kilowatts, and one unit of 150 kilowatts. One motor-generator set of 1,000 kilowatts capacity and one generator set of 100 kilowatts capacity for the excitation of the large turbo-units, will also be installed in this building. The alternating current power house, of steel construction, brick enclosed, 60 x 80 feet, will contain two turbo-generator sets of 6,250 kilovolt - amperes, to furnish power for driving the mills. The turbo-generator sets will be operated in connection with surface condensers manufactured by the Wheeler Condenser & Engineering Co., Carteret, N. J. The alternating current will be controlled and distributed by a large switchboard upon a raised balcony, which also will support the direct current switchboard. The switchboard circuits will be equipped with ammeters and with curve drawing meters, to automatically produce card records of the performance of all motors in order to show the power consumed in each department.

Pumping equipment will be located in a building 28 x 30 feet, the pump house having a capacity of 30,000,000 gallons a day. The blacksmith and general machine shop will be located in the upper end of the opening building. Attractive rest and dining rooms are being built for the use of girls employed in the tin house. These rooms will be located on the second floor of the restaurant, which is conducted by the company for the use of employes. The girls will have the use of individual lockers.

Retaining Wall Built

In order to utilize space between the mill building and the river front, it was necessary to construct a retaining wall extending for a distance of approximately 2,000 feet along the river. The wall, built of reinforced concrete, is 22 feet thick at its base and rests upon wooden piles driven through the mud bottom of the river to the shale below. The wall is 42 feet 6 inches high, and is provided with anchorage to permit the handling of coal barges. It was built by the E. M. Wischert Co., Pittsburgh.

FIG. 4—OLD ANNEALING FURNACE IN ANNEALING BUILDING, WHICH WILL BE REMODELED FOR STOKERS

Coal Storage Yard

The yard between the present boiler house and the river wall will be used for the storage of coal, which will be carried from river barges by grab buckets. Coal will be fed to a conveyor system under the boiler house through chutes by gravity, and after passing through the crushers will be elevated over screens into storage bins for furnace consumption. Fuel will be conveyed to the furnaces in steel cars, operating on longitudinal tracks and will be automatically dumped into the furnace bins. Coal for the boilers

will be handled by overhead cranes. Ashes from the boilers will drop into cars operating in a tunnel under the boiler house.

Construction of Buildings

All the buildings are of steel construction. Fabricated material for the extensions and additions was furnished by the Jones & Laughlin Steel Co., Pittsburgh, and erected by the Lawrence Steel Construction Co., Pittsburgh. Twelve new electric traveling cranes, in addition to the 10 serving the old plant, have been ordered from the Shaw Electric Crane Co., New York. The drive stands and the jack shaft stands, for driving the hot mills, were built by the Allis-Chalmers Co., Milwaukee, and the roll lathes and general castings were made by the Hyde Park Foundry & Machine Co., Hyde Park, Pa.

The growth of the McKeesport company has been rapid and interesting. During the first decade and a half of its existence, the concern will have increased the capacity of its plant 900 per cent. Organized in 1901, with a capital stock of $600,000, the rated capacity of the company's first 10-mill plant, which was completed in 1903, was 400,000 base boxes of tin plate per annum. During the ensuing four years the annual output was increased to 836,000 base boxes, an increase of more than 100 per cent. This increase was obtained through numerous changes and improvements in rolling mill practice. In 1909, the capital stock of the company was increased from $600,000 to $1,200,000, to provide for the addition of a 10-mill extension, which was completed the following year. Two more mills were installed in 1911, giving the company a total of 22 mills, with a rated annual output of 2,000,000 base boxes. Thus, in a period of 10 years, the company had increased its productive facilities 450 per cent. When the 20-mill extension is completed, the plant will be equipped to manufacture 4,000,000 base boxes of tin plate a year, an increase of 900 per cent over the output of the original 10-mill plant.. The capital stock of the company was recently increased to $3,000,000 to provide for the new addition.

When operating at capacity, the enlarged plant will require the following commodities for a 12-month period: From 200,000 to 225,000 tons of sheet bars; 4,000 tons of pig tin; 12,000 to 14,000 tons of sulphuric acid; 125,000 tons of coal and 700 to 800 tons of palm olive oil.

It is interesting to note that the personnel of the officers and directors of the McKeesport Tin Plate Co. has not changed since its organization. The officers of the company are: President, E. R. Crawford; vice president, E. P. Douglass; general manager, J. E. Lauck; secretary, G. V. Parkins; treasurer, W. L. Curry; auditor and assistant treasurer, H. M. Clark; chaiman of the executive committee, J. C. Smith. The original mill and all of the extensions were designed by S. Diescher & Sons, engineers, Pittsburgh, who have supervised the erection of all of the subsequent work.

IMPORTS AND DOMESTIC PRODUCTION IN TONS OF MANGANESE ALLOYS.

	Exports.		Production.	
	Ferro-Manganese.	Spiegeleisen.	Ferro-Manganese.	Spiegeleisen.
1915	50,000*	.....	160,000*	105,000*
1914	82,997	2,870	100,731	76,625
1913	128,070	77	119,495	106,980
1912	99,137	1,015	125,378	102,561
1911	80,263	20,970	74,602	104,013
1910	114,228	25,383	71,376	153,055
1909	88,934	16,921	82,209	142,831
1908	44,624	4,579	40,642	111,376
1907	87,400	48,994	55,918	283,430
1906	84,359	103,208	55,520	244,980
1905	52,841	55,457	62,186	227,797

*Estimated.

Ferro Manufacture in United States

(*Continued from page 25.*)

beginning of the year, 20 per cent spiegeleisen was at $25, furnace. In February, it went to $26, furnace. About Sept. 1, prices established themselves at $28 to $30, furnace, and prevailed at this level throughout the last half and at the close of the year. Sales were very heavy, for in addition to the increased production, a considerable stock on hand Jan. 1, 1915, was absorbed. The Steel Corporation was a heavy buyer of spiegeleisen in the year, taking perhaps a total of 20,000 to 30,000 tons.

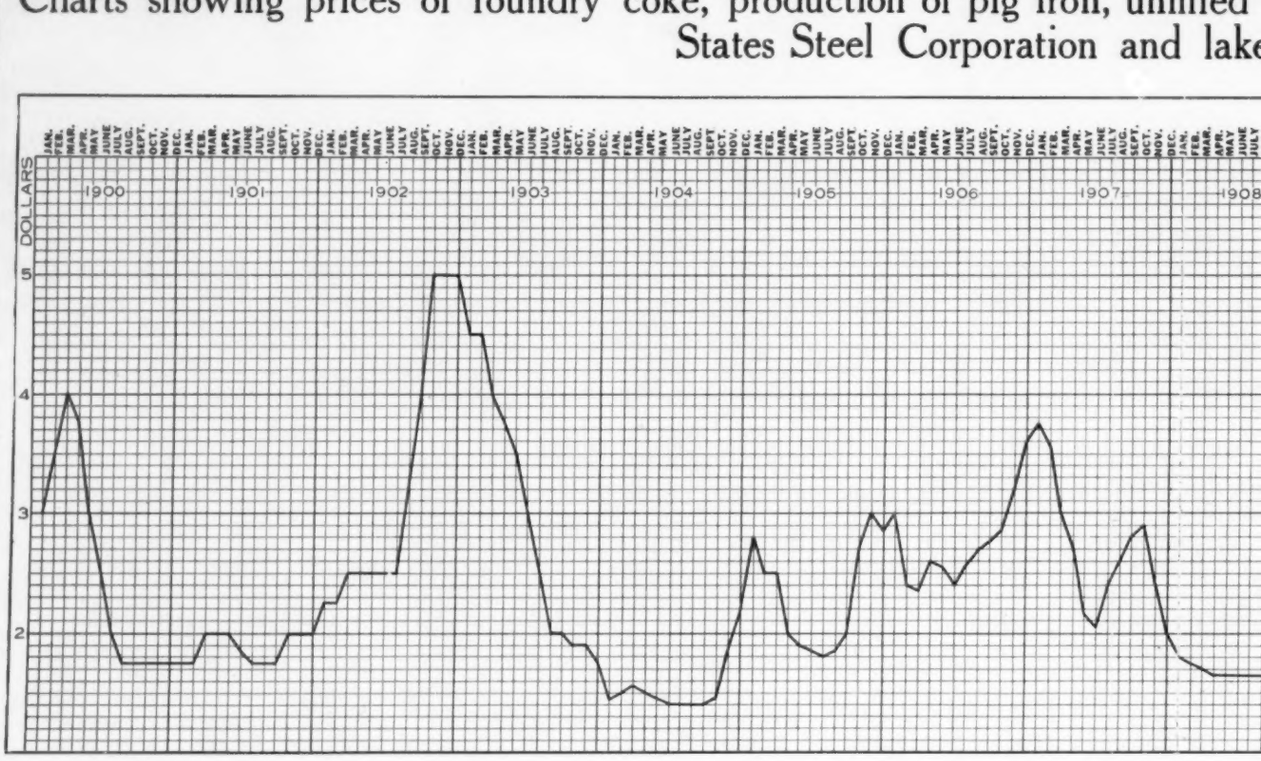
Much interest has been attracted in the trade by the operations of the American Manganese Mfg. Co., Philadelphia, which leased the blast furnace plant of the Dunbar Furnace Co., Pa., for the manufacture of ferro - manganese and spiegeleisen. This represents the most elaborate plan to make merchant ferro-manganese in a blast furnace in this country in several years. A large tonnage of 80 per cent and lower-grade ferro-manganese, and of spiegeleisen was made for the market. Manganiferous ores from the Cuyuna range, domestic and imported manganese ores were used in the mixture in making low grade ferro. For the production of standard 80 per cent ferro-manganese, Brazilian ore mainly was consumed.

Manganese Ore Jumps

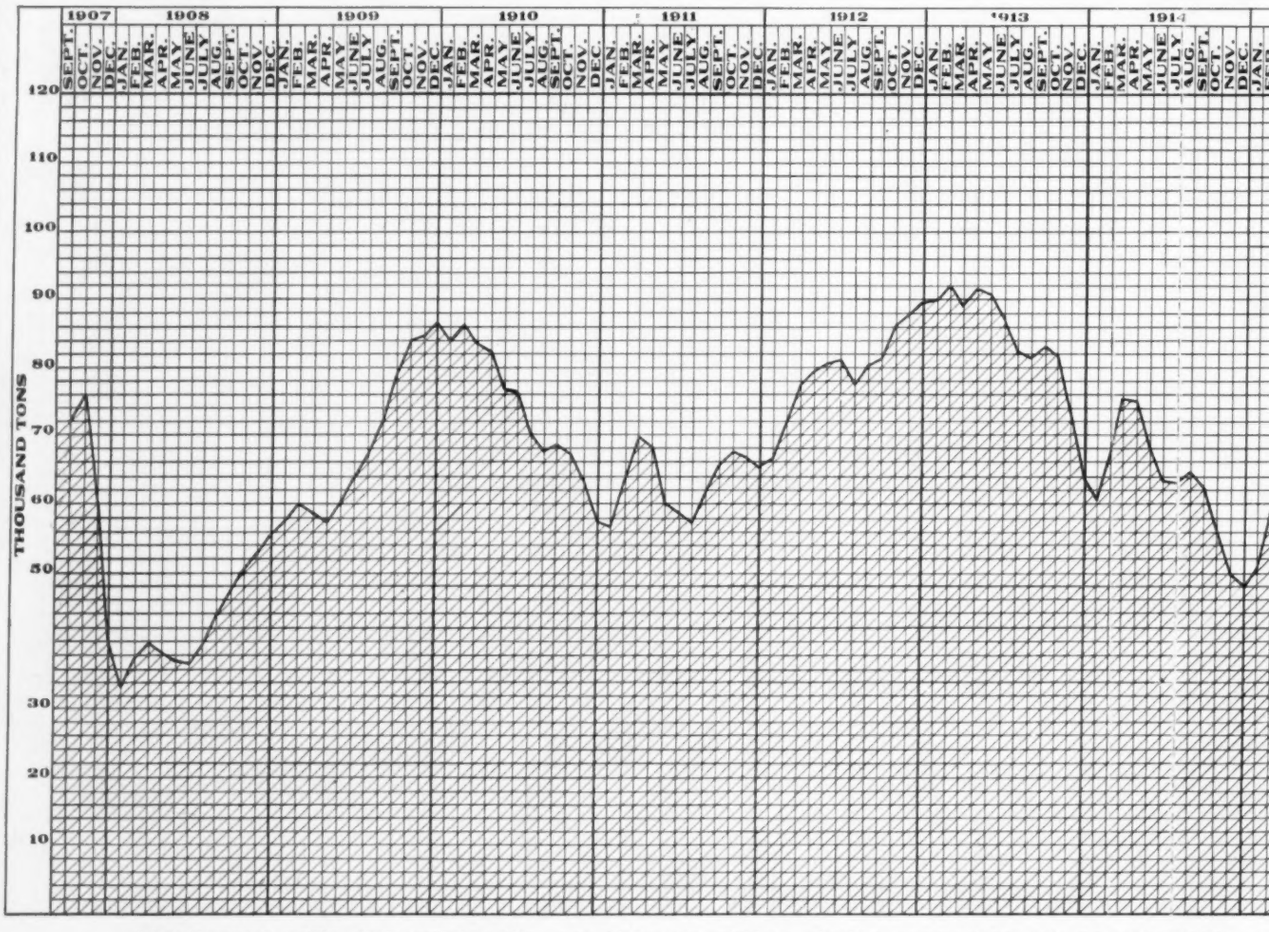
The manganese ore market in the United States in 1915 has shown the highest prices ever known, because of the reduced supply due to the continued shutting off of all ore from the Russian Caucasus by the closed Dardanelles, to the unprecedented ocean freights, and to the increased demand for this material. Brazilian and Indian ore, chiefly the former, have figured in the market. More Brazilian ore was sold in this country than ever before and some of the tonnage which heretofore had gone to England or Germany was diverted here. This mineral was in great demand, for it represented the only foreign manganese ore that could be purchased in tonnage in this country without the buyer subscribing to the guarantees demanded by the British government against exporting steel or ferro-manganese to the enemies of the latter. Brazilian ore brought as high as about 44 cents per unit, alongside the steamer at Rio Janeiro, or about 56 cents per unit at Atlantic ports, in this country. About a year ago, it had been sold at 18 cents per unit at Philadelphia. The Steel Corporation was a very large buyer of Brazilian ore, closing probably for 150,000 tons in the year. A considerable tonnage of this, under a transaction closed in September, was for the first half delivery in 1916. Other makers of ferro - manganese bought freely of Brazilian ore. The Dunbar furnace operated for a considerable part of the year, on a mixture of this ore and domestic manganese or manganiferous ores. Sales and shipments of Indian ore to this country in 1915 probably were 30,000 tons. In August, 1914, shortly after the outbreak of the war, this ore was sold at a price of 26 cents per unit at tidewater.

THE IRON TRADE

Charts showing prices of foundry coke, production of pig iron, unfilled
States Steel Corporation and lake



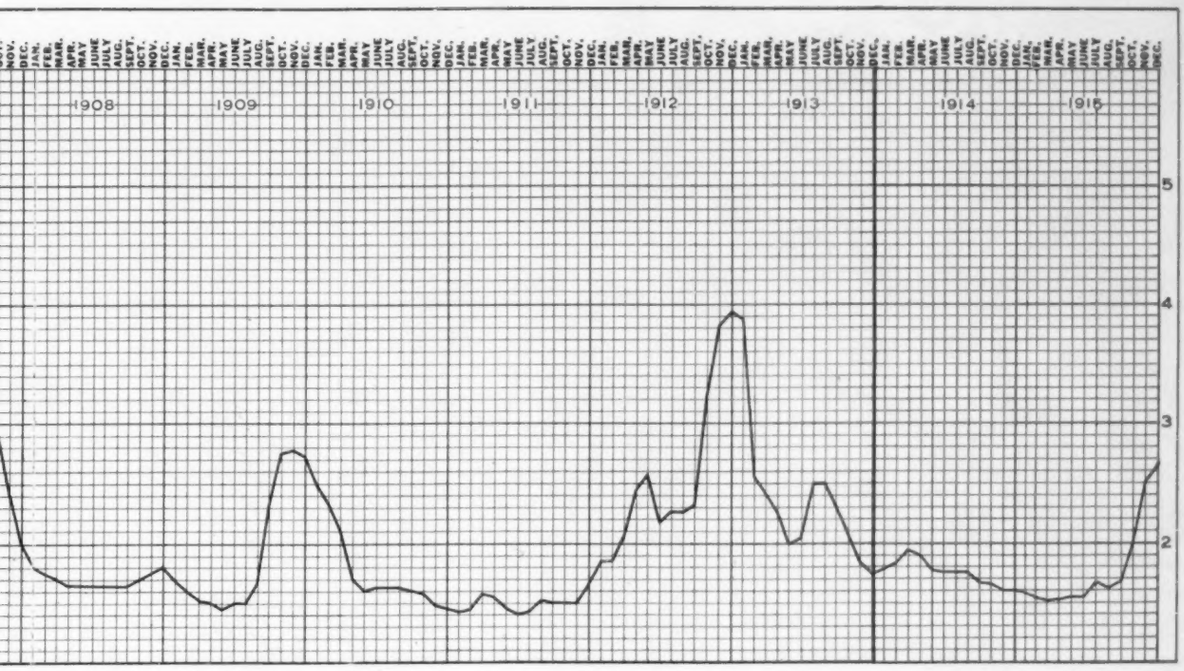
PRICES AT OVENS OF CONNELLSVILLE FURNACE C



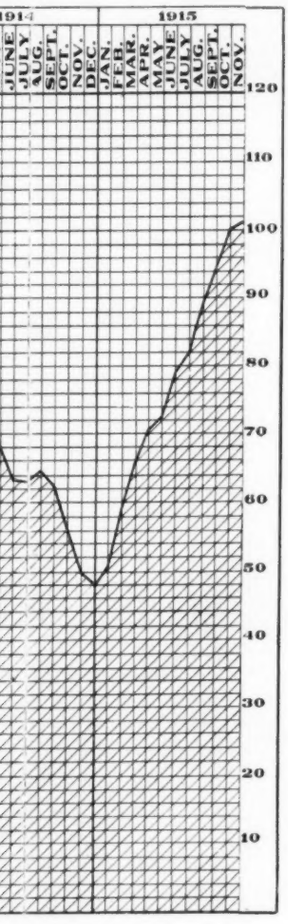
PRODUCTION COKE AND ANTHRACITE PIG IRON IN UNITED STATES SEPTEMBER, 1907 TO NOVEMBER, 191

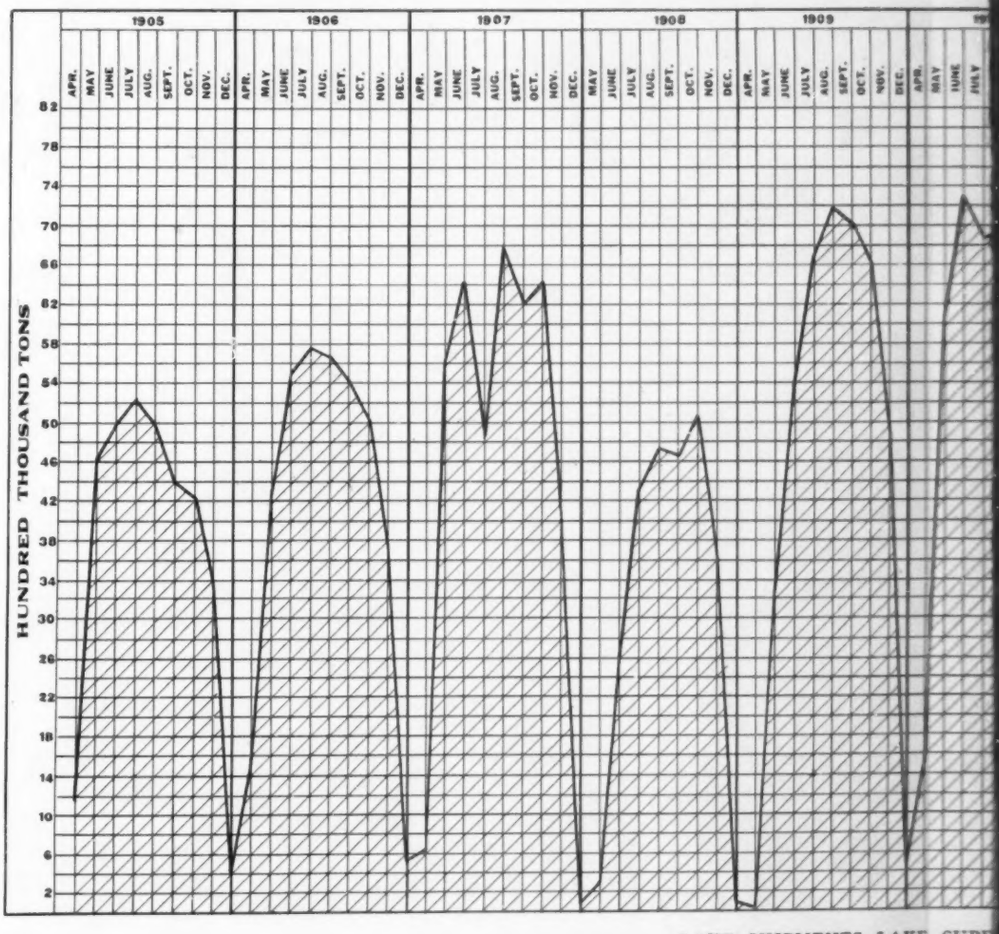
RADE REVIEW

nfilled tonnage United States Steel Corporation, net earnings United
nd lake shipments of iron ore.



FURNACE COKE, PROMPT DELIVERY, 1900-1915





VEMBER, 1915

LAKE SHIPMENTS LAKE SUPE

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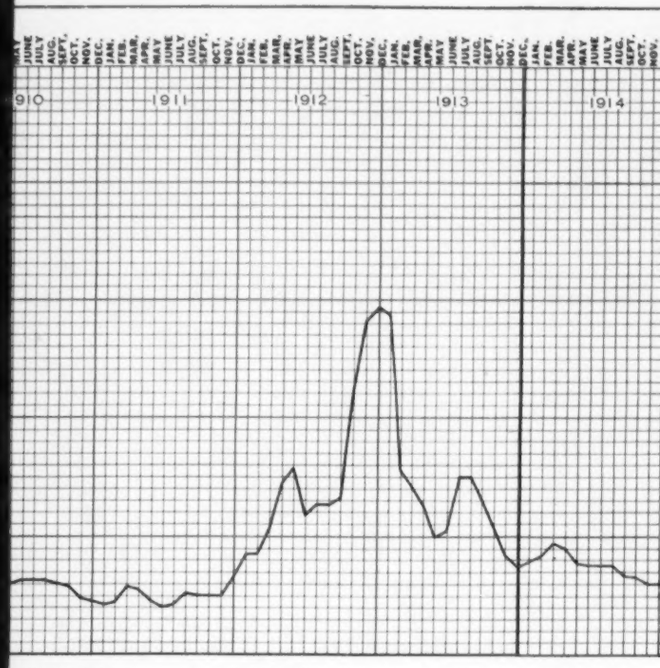
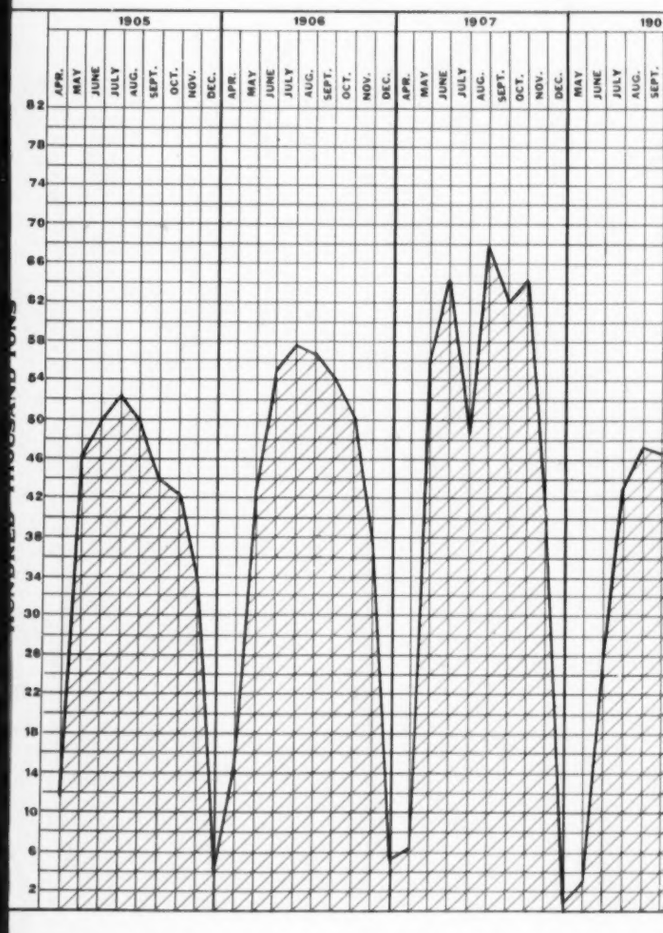
iron ore.



, 1900-1915



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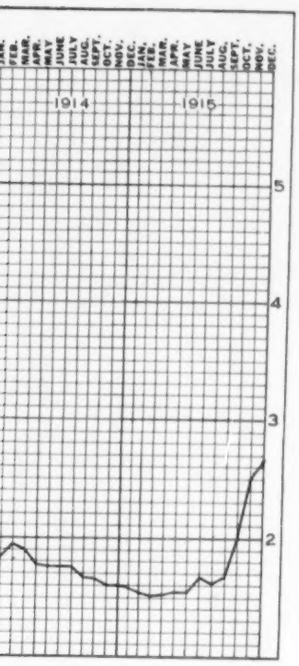
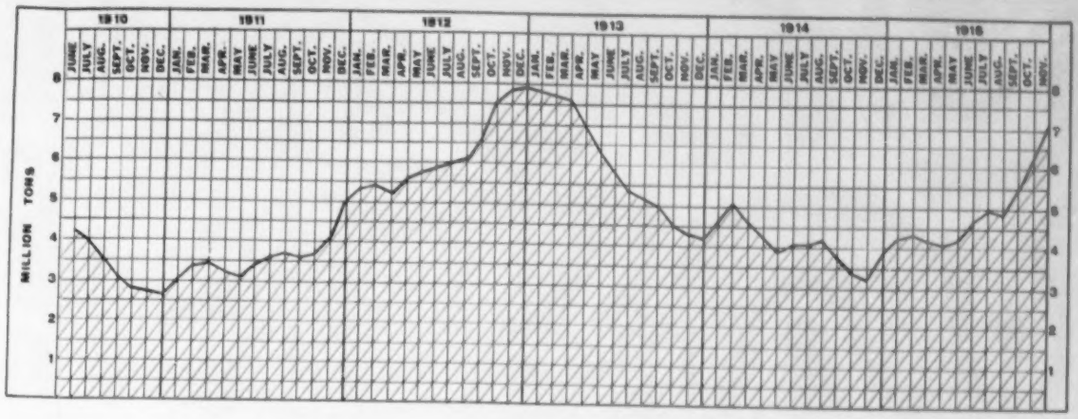
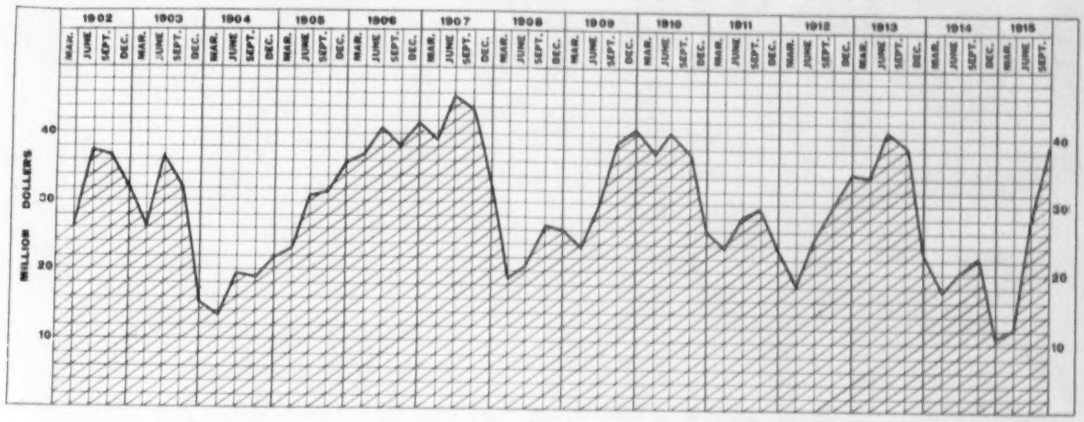
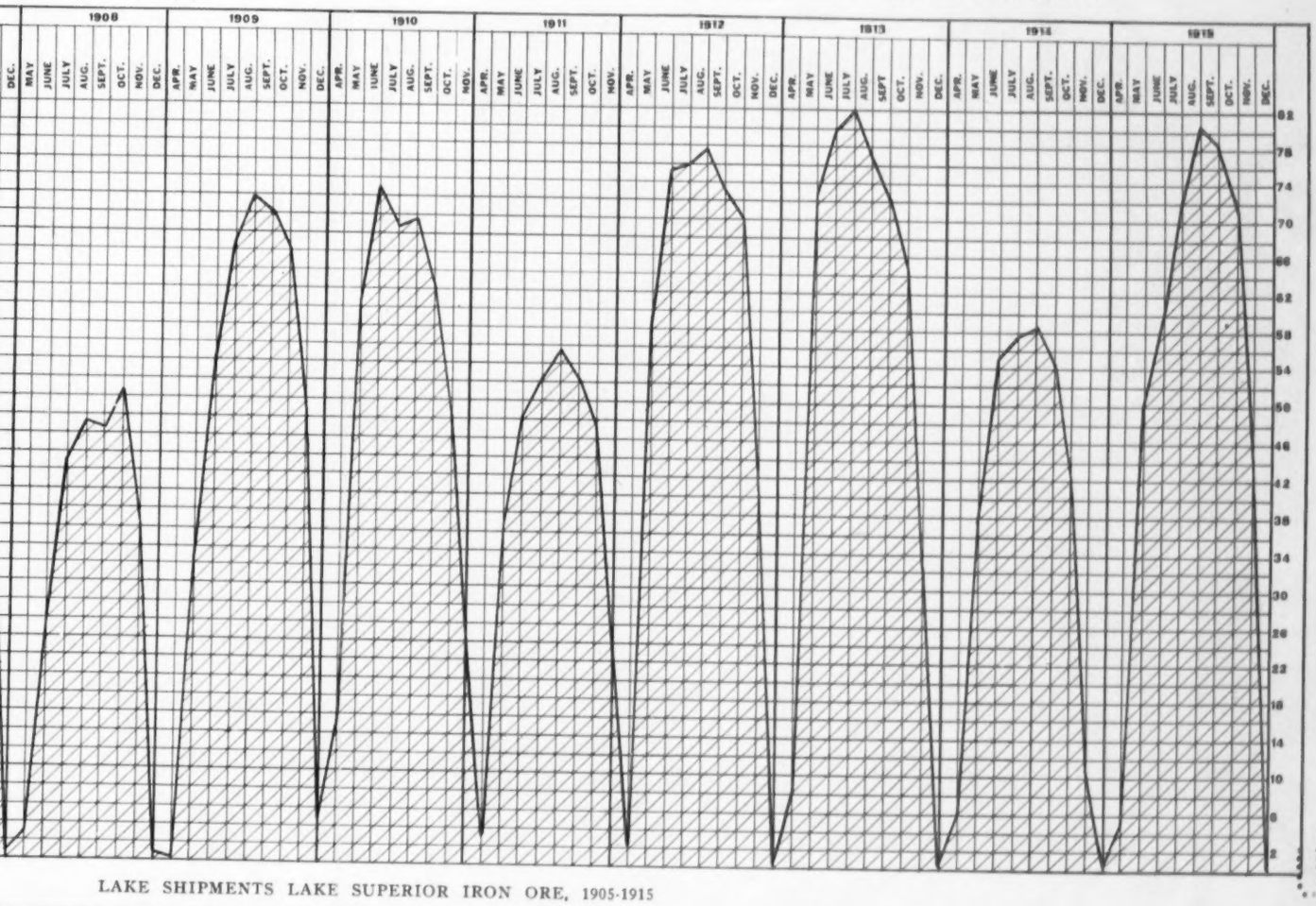




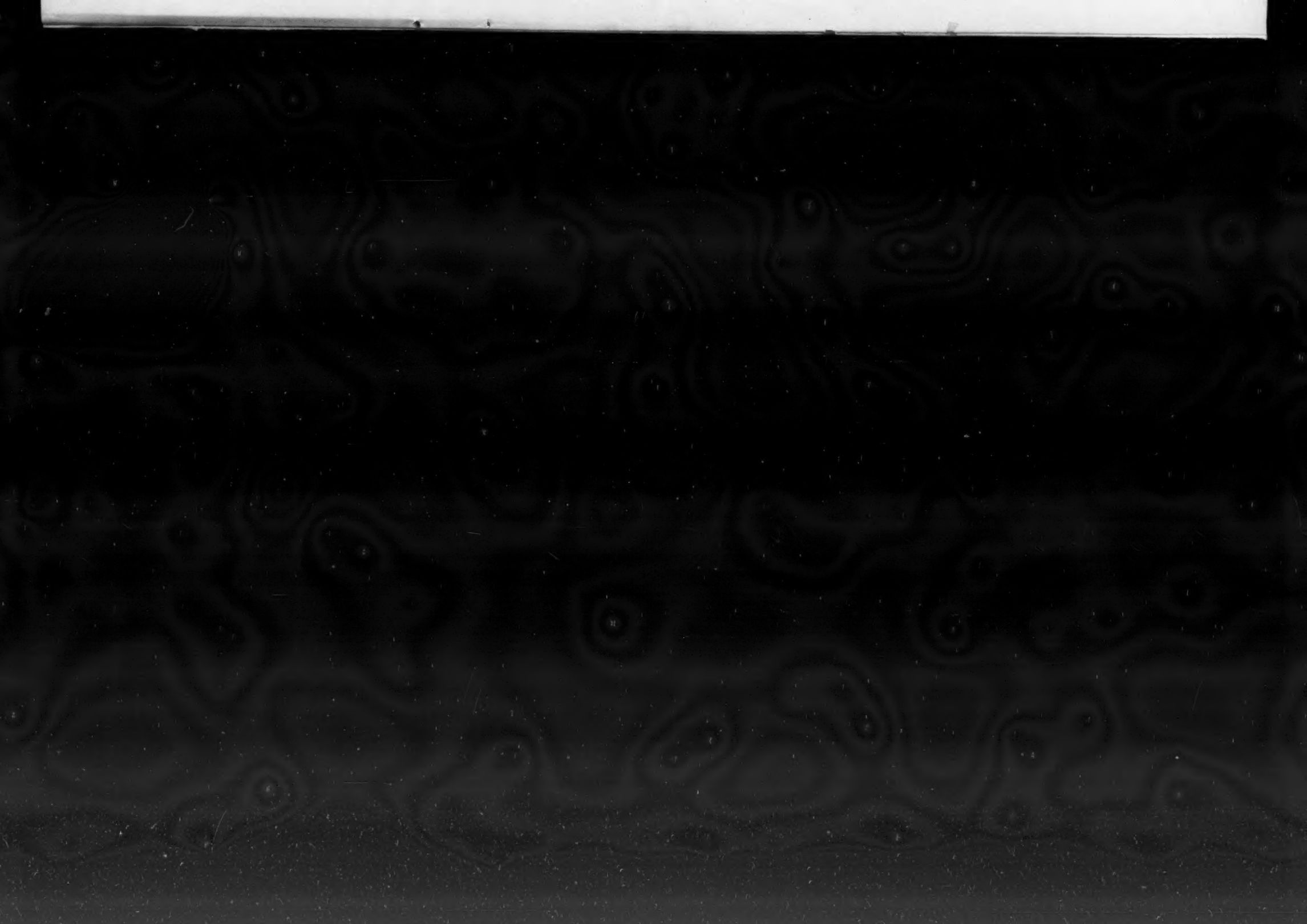
UNFILLED TONNAGE UNITED STATES STEEL CORPORATION, 1910-1915



NET EARNINGS UNITED STATES STEEL CORPORATION, 1902-1915



LAKE SHIPMENTS LAKE SUPERIOR IRON ORE, 1905-1915



How Steel Pens Are Manufactured

AMONG various industries transplanted from England to the United States, the manufacture of steel pens is of special importance. Pens are now protected by a specific duty of 8 cents per gross; but before the war large quantities were imported. This article explains the method of preparing the steel and the process of manufacture in one of America's foremost plants. Much skilled hand labor is necessary.

By E. C. Kreutzberg

AS EVERY word immediately suggests certain related words, the word steel usually brings to mind railroads, bridges, skyscrapers, boats, machinery and a host of other terms conveying a sense of tonnage. It is less often that we think of pocket knives, the mechanism of our watches, button hooks, scissors, fountain pen clips, key rings, and a hundred other small articles which we use to such an extent that they almost are incorporated in our personalities. It sometimes is said in a casual way that steel is the most wonderful of the metals. In far from a casual way, this statement, in its full meaning, is not at all exaggerated. Steel can be alloyed with almost innumerable elements, each of which affords it different physical characteristics. Steel may be softened by raising it to a high temperature and cooling slowly; it may be hardened by raising it to the same temperature and cooling suddenly. There is almost no limit to the different characteristics it may assume, and it is due to this adaptability that we have the countless small steel articles which serve mankind for one purpose or another.

Such small articles often represent much more complicated processes of manufacture than the more bulky steel products. By reason of their lack of size, the limits for variations in measurement, weight, and many other factors, must of necessity be exceedingly fine, and each stage in the manufacture of such products as watch springs, writing pens, etc., calls for skill of a highly specialized order, and for great accuracy in mechanical operations. Our interest in writing pens, for instance, is limited, as a rule, to determining on the style of pen that best suits our hand; we do not stop to consider that we expect all pens of the same style to be alike, that each pen in a gross box which we buy today shall have the same "spring" and shall make a line of the same width as the pens in a gross box which we purchased five years ago.

Where Small Defects Loom Large

The maintenance of such uniformity makes it necessary that all stages of the process of manufacture be uniform. In order that a pen of a certain style may continue to show unchanged writing characteristics, it is essential that the thickness of the steel, the location and length of the side slits, and the effects of heat treatment be absolutely uniform in each pen; furthermore, not only must the width of the writing point remain unvaried, but the pen must be slit exactly in the center, as any difference in the width of the two nibs will result in faulty writing. For the ordinary steel pen, in fact, there are 18 to 20 possible chances for a defect, any one of which is sufficient for rejection. In some pens which involve a more complicated process of manufacture, such as the small, fine-pointed pens which artists use, there are as many as 25 to 26 possible chances for rejection.

The output of steel pens in this country now is proceeding at the rate of approximately 3,000,000 gross, or 432,000,000 pens a year, which is nearly 1,500,000 pens each working day. While these figures appear large, it must be remembered that a little steel goes a long way in making pens. The average net weight of a gross is three ounces. Thus 500 tons,

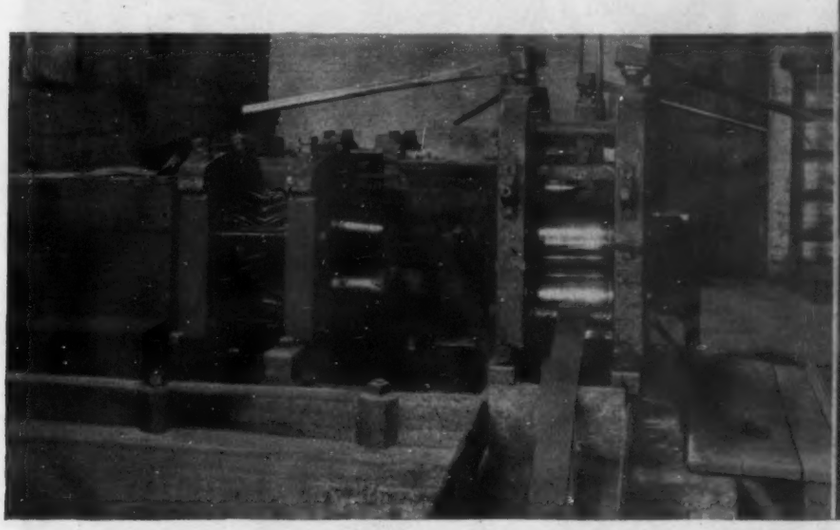


FIG. 1—ENGLISH HAND-PRESSURE ROLLS EMPLOYED AT PLANT OF C. HOWARD HUNT PEN CO., CAMDEN, N. J., FOR COLD-ROLLING 4-INCH STRIP-STEEL TO FINE GAGES REQUIRED FOR PEN-MAKING

FIG. 2—INSPECTING FINISHED PENS
The finished pens are carefully inspected for imperfections, the presence of any one of 18 to 26 defects being sufficient to cause rejection.

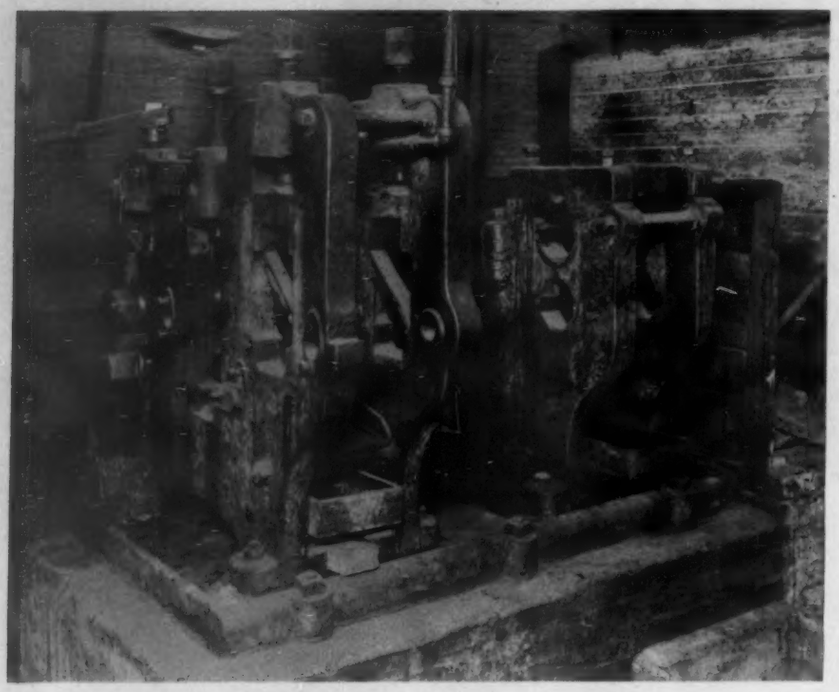


FIG. 3—AN ENGLISH MILL DESIGNED FOR CONTINUOUS ROLLING
This mill had three sets of rolls in one block. The continuous feature not having proved successful in operation, two sets of rolls were removed and the third set now is used as a roughing stand

which makes ample allowance for the waste entailed, easily covers the annual steel requirements of the pen manufacturers in this country. The industry is growing rapidly in this country and pen manufacturers say that, due in part to the cutting off of imports by the war, they are busier than ever before in their history. Although pens have been manufactured here for a great many years, the process by which they are produced still is essentially the same as introduced from England, which country has been the home of the pen-making industry since steel pens first began to succeed the quill in 1840. Not only are steel pens now manufactured in America by methods originated in England, but the pens in most cases are produced under the supervision of expert workmen brought from England and, to a large extent, by equipment made in that country.

American Steel for American Pens

Up until comparatively recently, the penmakers went so far as to buy even their steel requirements in England, contending that English steel was superior for their purposes to the product of the domestic makers. Within the past few years, however, the efforts of steel mills in this country to produce satisfactory pen steel have met with such success that now they are furnishing a constantly and rapidly growing percentage of the requirements. For making pens, steel with a carbon content averaging about 1 per cent is required. This is furnished annealed, after rolling to exceedingly fine gages, especial care being required for securing uniformity of rolling and accuracy of gage.

A plant which reflects in notable degree the large production, the skill and efficiency of the workers, the precision of mechanical operations and the many other factors which are vital to the successful pursuit of the steel pen industry, is that of the C. Howard Hunt Pen Co., Camden, N. J. This concern is completely equipped, not only for all stages of the manufacture of pens, but also for rolling a portion of its steel requirements to the fine gages required. The steel must be in strips sufficiently wide to permit the stamping out of the pen blanks along two parallel rows, the points of the blanks in one row dovetailing between the points of the blanks in the other row; this method admits of the utilization of the steel with a minimum of waste.

Two Sources for Raw Material

The company purchases its raw material both in the form of strip steel and as hot rolled sheets. The strip steel comes in coils, is cold rolled and annealed and is of specified gage and width, so that it may be blanked without preliminary treatment; this steel up to a few years ago was imported exclusively from England, but now is obtained from domestic makers. The hot rolled sheets, which like the strips, have a 1 per cent carbon content, are imported from England, where they are rolled by a well-known Sheffield maker. To get them in suitable form for making pens, they are cut up into strips, pickled and cold rolled down to gage.

The pickling and tumbling operations are performed simultaneously, the strips, which are 19 inches long, being tumbled in a watertight brass cylinder, 2 feet long and 15 inches

FIG. 4—HARDENING THE PENS AFTER STAMPING
To harden the pens, after they are raised, they are placed in cast iron boxes, containing five pounds each, and heated to a temperature of 1,300 degrees Fahr. They then are quenched in whale oil.

in diameter. The barrel contains the pickling solution and thus the scale is removed from the strips as fast as it is loosened. In this way, the cleaning operation is considerably expedited. The rolling mill equipment was imported from England and includes a 2-high mill with three finishing stands, made by William George Jones, Lion Hill street, Birmingham, and a second mill made by William Hewitt, Birmingham. The Jones mill is shown in Fig. 1 and the Hewitt mill in Fig. 3. The latter originally was designed as a continuous mill, being provided with housings for three sets of rolls. Not having proved successful at continuous rolling, this mill has been stripped of two sets of rolls, the remaining set serving as a roughing stand in connection with the Jones mill. All the rolls are of chilled iron and are 7½ inches in diameter. The four stands are driven, through gears and pinions, by a 150-horsepower engine.

As received at the plant, the hot rolled sheets are 0.023-inch thick. By repeated passes and skillfull rolling, this steel, after being cut into strips, is reduced to the standard thicknesses required for the various pens which are 0.004, 0.007, 0.0075, 0.008, 0.0085, 0.009, 0.00925, 0.0095, 0.0105, 0.011, 0.012 and 0.0125-inch, the maximum permissible variation in each case being 0.00025-inch. The product of these mills also is devoted to other uses than the manufacture of pens. The finest gage produced is 0.002-inch, which is used for dental purposes. To be reduced to this thickness, the steel undergoes approximately twenty passes. All of the rolling is done cold and without any heat treatment after the initial annealing. The only exception is in the case of 0.002-inch steel, which is re-annealed once during rolling.

In the production of pens, the volume of output, aside from the matter of quality, is the factor for prime consideration. Inasmuch as each pen, during its conversion from the raw material to the finished product, passes through a definite number of exact stages, the process of manufacture is an ideal one for the application of the principles of motion and time study. This is especially true in view of the fact that the human element remains the vital factor despite efforts which have been made to render all steps in the process as automatic and mechanical as possible. The most satisfactory results have been obtained, up to the present time, by the use of hand machines, each designed to perform a certain operation, and guided by a worker specializing in that operation. The machines employed throughout in the stamping and forming of pens are, with a few exceptions, of the ordinary, hand-power, screw-press type, illustrated in Figs. 7 and 9. The performance of each machine, depending on the particular work to which it is adapted, ranges from 20,000 to 80,000 strokes per day of eight hours.

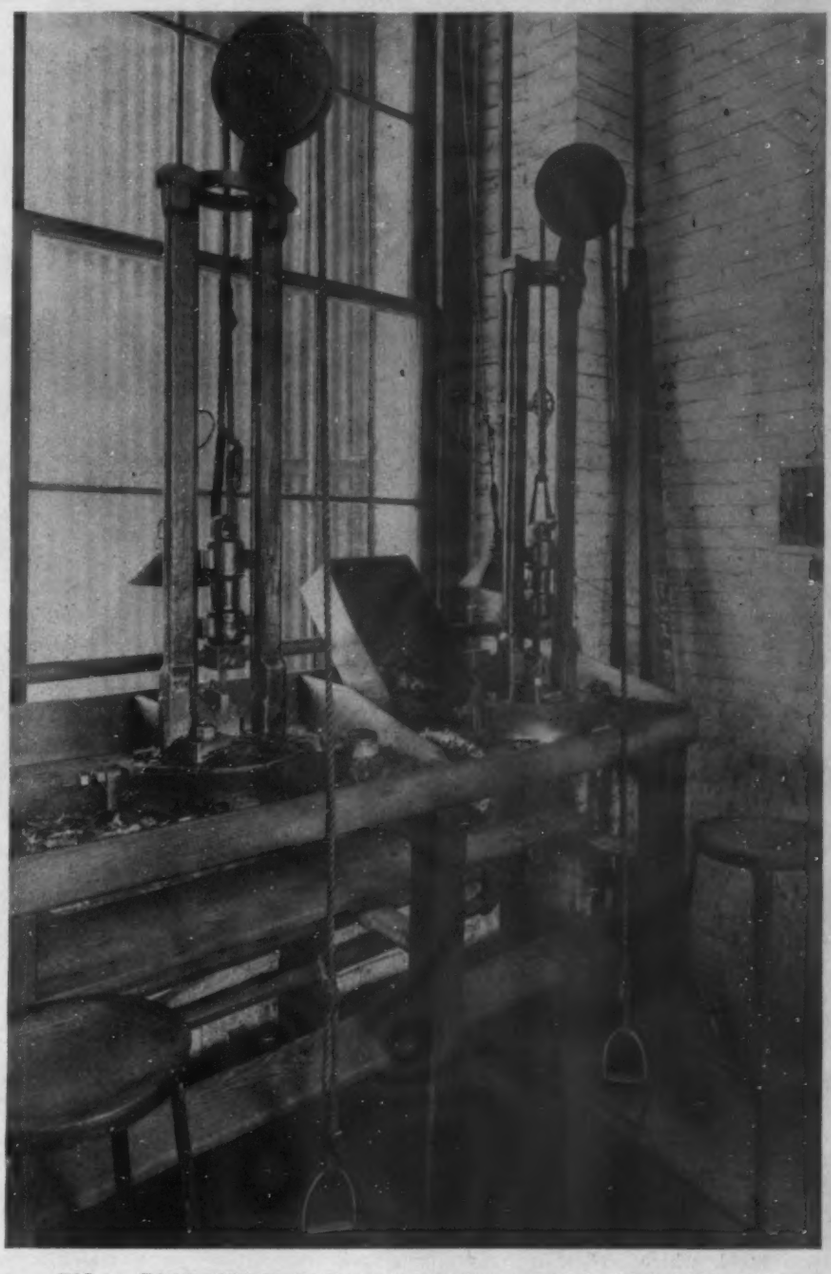


FIG. 5—FOOT-POWER, DROP-HAMMER TYPE PRESS EMPLOYED FOR MARKING PEN BLANKS

The blanks are marked with the name of the maker, the number of the style and other characters familiar to the pen-user.

The first stage in the process of actually forming the pen is the stamping of the blanks from lengths of strip steel, as shown in Fig. 7. In order to eliminate waste as much as possible, these strips, as stated previously, are just wide enough to permit the stamping out of two staggered rows of blanks, so arranged that the points of the blanks dovetail. The capacity of the hand presses engaged on this operation is approximately 60,000 to 80,000 blanks each, daily. These presses mark each blank

with a slight raise or nick to indicate which side will form the top of the pen since it is desirable to keep the microscopic burrs, formed by the stamping press, on the top side, where they are not likely to cause any trouble. The next operation also is performed on hand-screw presses, each of which pierces and side-slits approximately 20,000 blanks daily. For piercing and side-slitting ordinary pens, one operation suffices, but for pens which are pierced and side-slit to a special or fancy design, two or three operations frequently are necessary. At this stage of the process, the blanks are annealed. For this purpose, they are put into round steel pots, each having a capacity of 30 pounds of blanks. The pots are sealed with bone charcoal and placed in a coal-fired muffle furnace, where they are brought to a temperature of 1,300 degrees Fahr. They are then removed, placed on a brick floor and permitted to cool slowly for 24 hours in a steel hood, which is lowered over them. This method is illustrated in Fig. 6.

The blanks, after being removed from the pots, are transferred to a foot-power press of the drop-hammer type, which marks them with the name and number and any other desired character. These presses, illustrated in Fig. 5, are provided with 17-pound hammers, which have a drop of 6 inches. Fig. 6 shows a type of automatic machine which has come into use lately. This machine not only combines the blanking and marking operations, but makes two blanks at each stroke. After marking, the blanks are raised, or rounded, in a hand-screw press, of the type illustrated in Fig. 9. To increase the efficiency of these presses, they are provided with air nozzles which blow the pens away from the dies as soon as they are formed.

The Heat-Treating Process

The pens then are returned to the heat-treating room and hardened. For this purpose, they are packed in cast iron trays, approximately 5 pounds of pens per tray. The trays, after being covered with lids, are placed in the muffle furnace, brought up to a temperature of 1,300 degrees Fahr., and are then removed, the pens, as shown in Fig. 4, being discharged from the trays into draining pots, which are suspended in a vat of whale oil. The pots next are taken out of the vat and placed on an angle iron flat form to drain off the surplus oil. The pens later are freed entirely of oil, first by being placed in a centrifugal machine, and later by immersion in a solution of caustic potash. They next are placed in a gas furnace, which draws the temper to a blue color, at 600 degrees Fahr. Following this heat treatment, which is the last in the process, the pens are tumbled to remove the scale. The abrasive employed for this purpose is obtained by crushing old crucibles made from fire clay, and is to be had exclusively in England, since no clay crucibles are manufactured or used in this country.

The pens are now transferred to the grinding room, where they are ground across the backs of the nibs, tapering them slightly toward the point. This grinding is done on machines of a special design. Each machine embodies the use of a narrow belt passing over two pulleys operating in connection with a small grinding wheel. The operator places each pen so that its shank will be held against the face of the larger pulley by the belt, and thus the nibs of the pens, in the revolution of the pulley, are brushed against the face of the rapidly-rotating grinding wheel. Each of these machines has a capacity for grinding 30,000 pens daily.

The last mechanical operation is the slitting of the pen, which is reserved until this stage, due to the fact that a pen cannot be hardened or annealed after slitting, since any great increase in temperature would result in warping the nibs. The slitting operation is performed on hand-power presses, similar to those utilized for blanking and raising the pens. Each of these machines, when handled by an efficient operative, slits from 15,000 to 20,000 pens daily. The slitting operation is the most delicate of the mechanical steps through which a pen passes, since the knives not only must be hard and sharp, but they must be so placed that the pens

FIG. 6—AFTER PIERCING AND SIDE-SLITTING, THE BLANKS ARE ANNEALED IN STEEL POTS

The pots each hold 30 pounds of blanks. They are brought to a temperature of 1,300 degrees Fahr., and are placed under a steel hood to cool for 24 hours.

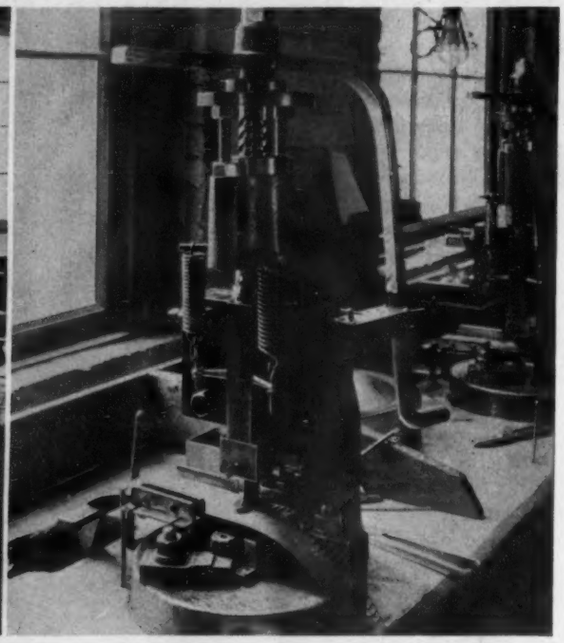


FIG. 7—HAND-OPERATED SCREW-PRESS USED IN PEN MANUFACTURE

The machine shown is engaged in stamping pen blanks from strip-steel

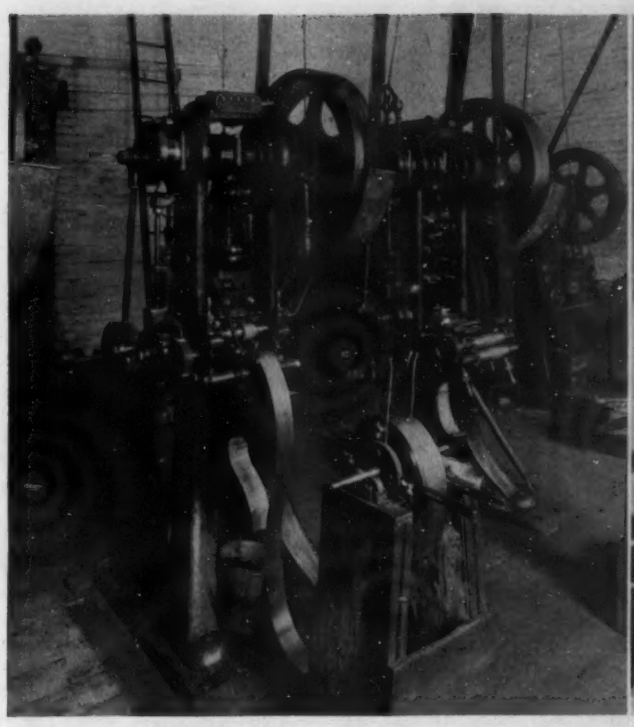


FIG. 8—AUTOMATIC, ROLL-FEED PRESS, RECENTLY ADAPTED TO PEN-MAKING

This machine stamps two blanks at a stroke and combines the blanking and marking operations.

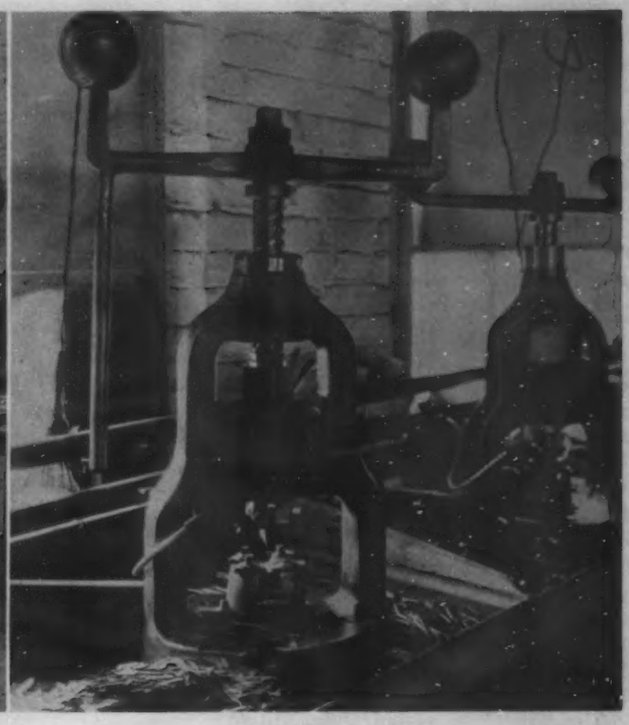


FIG. 9—RAISING, OR ROUNDING, PENS ON A HAND-POWER, SCREW PRESS

To increase the output, this machine is equipped with an air hose which blows the pens away as fast as they are formed

will be slit exactly along the center line. Any slight difference in the widths of the two nibs of a pen unfits it for use.

The pen now is completed, except for the fact that it will not yet write. At this stage, the application of the pen to paper would result in a few furrows and a general splattering of ink. Before the pen can be placed on the market, it must be freed of all sharp and rough edges, which might catch in the paper. The pens, therefore, after being slit, are tumbled with "pot" for a period which averages about 30 hours. The tumbling equipment, a portion of which is shown in Fig. 10, consists of frames, constructed of steel angles, which are centered on short pieces

(*Continued on page* 112c.)

FIG. 10—TUMBLING PENS IN SPECIAL CONTAINERS

To remove all burrs and rough edges, in order to make them write satisfactorily, the pens are tumbled in shaking pans for a period generally averaging 30 hours. A record of each lot is kept on a separate card.

Newest Type of Merchant Bar Mill

FEW PHASES of the iron and steel industry have received greater study and attention than merchant bar mill construction. Present day methods, consequently, bear little resemblance to the practice common even a comparatively few years ago. The Carnegie Steel Co., however, at its new Duquesne mill has incorporated a number of improvements permitting increased production with decreased manual labor.

THE new 10-inch merchant bar mill at the Duquesne, Pa., works of the Carnegie Steel Co. was built for two purposes. The company desired not only to convert a greater percentage of the product of the steel works into finished bars, but also to accomplish this, if possible, in a more economical manner than formerly.

The range of the mill is from ⅜ to 1⅝-inch rounds; it also rolls squares and flats of corresponding areas as well as the various kinds of deformed bars demanded by the trade. All bars are rolled from 1¼ to 2½-inch billets, 30 feet in length.

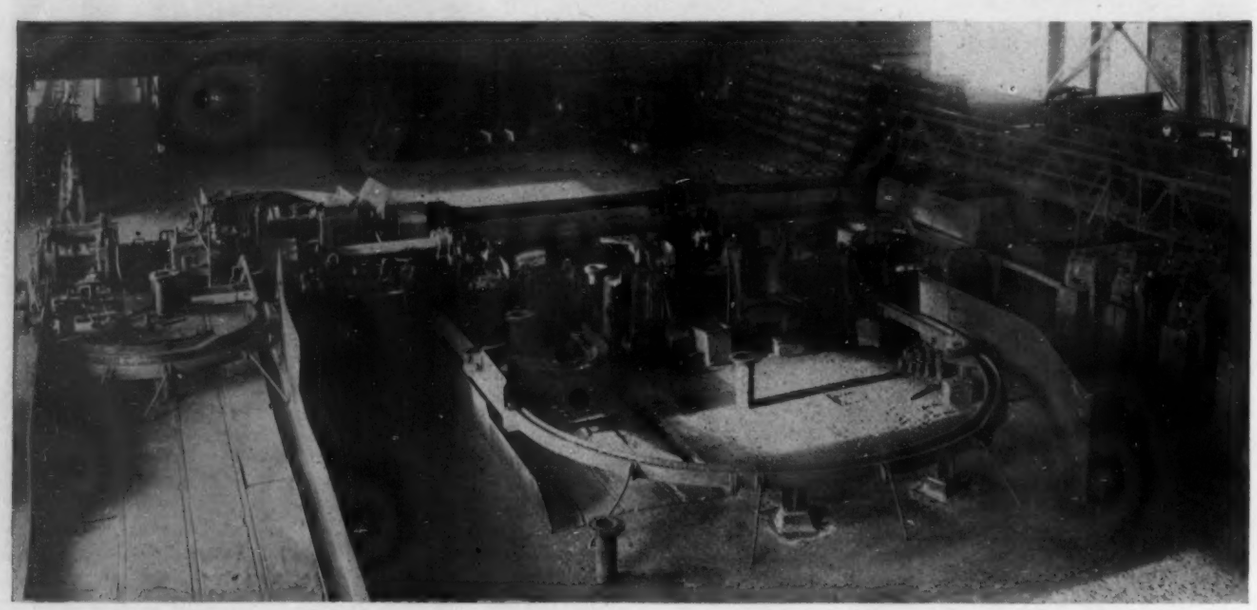
The billets are stored and assorted in the billet storage building. This structure is commanded by a 30-ton electric crane. Two hooks are provided so that the bundles of billets can be handled in parallel, in and out of the pockets in the storage building and parallel with the billet delivery table into the heating furnace. The furnace is of the recuperative type, with fan blast to force the air through the recuperators and under the hearth before mixing with the natural gas for combustion. The furnace hearth is 25 feet long. The billet table is provided on each side with skids, on which the bundles are spread out, so that one or two billets at a time, can be conveyed into the furnace. After the table has conveyed the billets into the furnace, an electrically operated pusher transfers the whole bed of billets in the furnace, giving it a sidewise motion sufficient to allow new billets to again enter the furnace. At the same time, one billet at a time is discharged at the other end of the furnace, by means of a push bar and electrically operated friction rollers placed a sufficient distance outside of the furnace to permit them to grip the front end of the hot billet. These rollers convey the billet into the first set of roughing rolls.

Four sets of roughing rolls are provided, each 11¾ inches in diameter. They are the regular continuous type, and are driven by gearing from a rope pulley shaft. There are also six pairs of finishing rolls, 10½ inches in diameter, driven by ropes from a rope pulley shaft which is placed directly in line with the motor shaft and is coupled to the latter by a sleeve coupling. Each two stands of finishing rolls are driven by a spindle and rope pulley, except pairs 9 and 10, which are actuated by two independent spindles and pulleys. The speeds of the finishing rolls are varied so that a bar being engaged by the various rolls, will produce either a stationary or slightly growing loop between successive pairs of rolls.

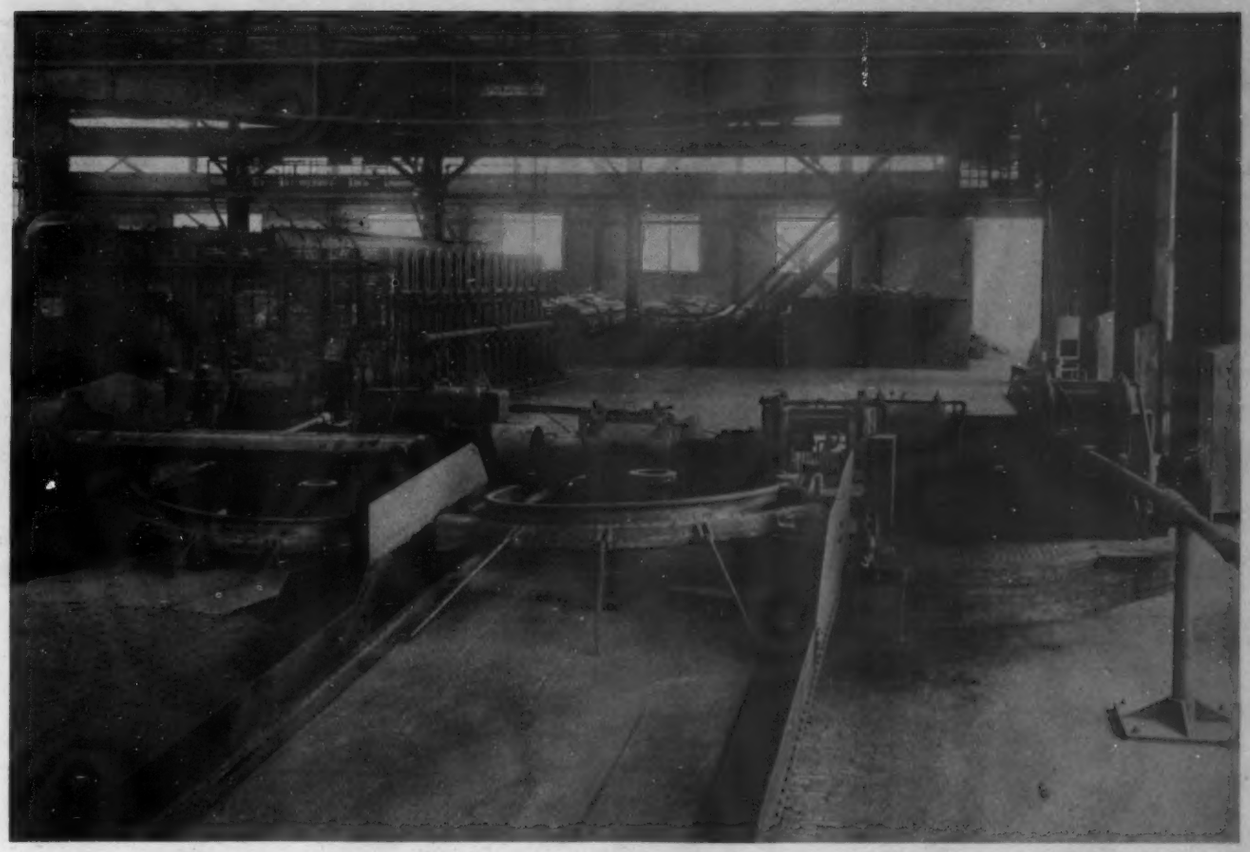
Beginning with the fourth pair of rolls in the roughing mill, and between all the stands in the finishing mill, repeaters are installed for automatically conveying the end of the bar from one set of rolls to the next and entering it into the pass. All manual labor around the mill is thus eliminated while rolling. Trumpet guides are provided at the delivery side of some of the rolls. The guides slightly twist the bar, so that it enters the following rolls in the proper manner.

The mill is operated by a 1,500-horsepower electric motor using 6,600-volt current. The motor has two synchronous speeds, 162 and 182 revolutions per minute. It is provided with resistance for intermediate and lower speeds if these should be required. The two synchronous speeds of the motor, correspond to the delivery speeds of the last finishing rolls. These speeds are 1,005 and 1,128 feet per minute, respectively.

After the bar leaves the last set of finishing rolls, it is conveyed through a pipe on to the rope-driven hot runout table, which extends the full length of the cooling bed. The hot run-out table is provided on one side with a permanent trough or V-



REPEATER BETWEEN STAND NO. 5 AND STAND NO. 8 AND REPEATER ON FINISHING STAND



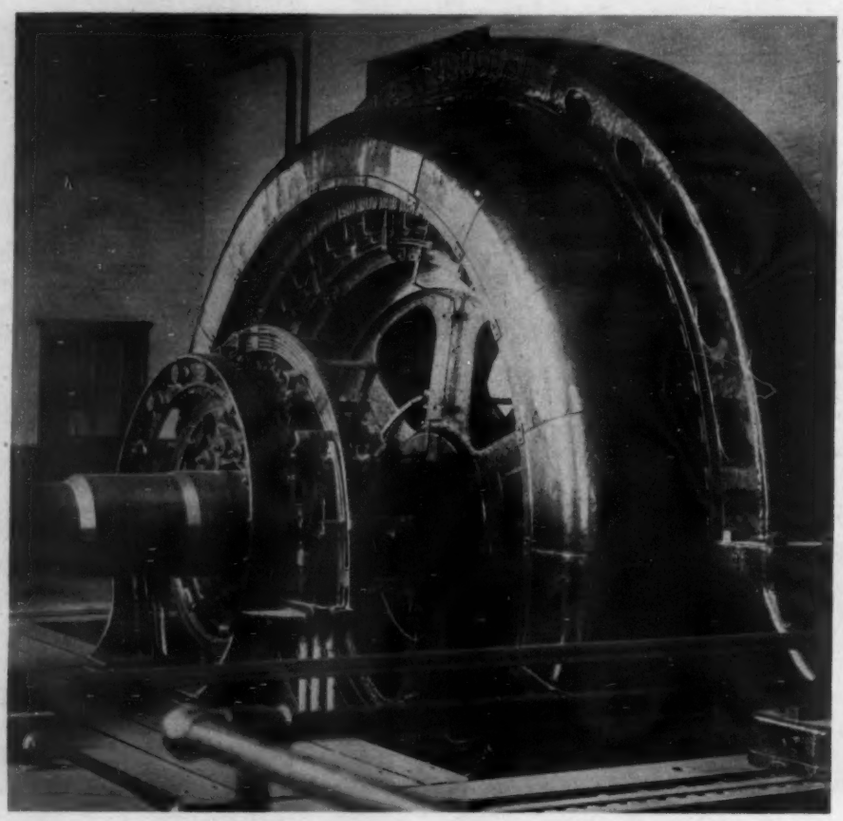
NEW MERCHANT BAR MILL AT DUQUESNE SHOWING HEATING FURNACE, REPEATERS AND BILLET STORAGE

MOTOR HOUSE, FOUR STANDS OF ROUGHING ROLLS, REPEATERS AND ROPE DRIVES TO FOUR FINISHING MILL SPINDLES

COOLING BED BUILDING SHOWING HOT RUN-OUT, THREE TRIGGERS FOR AUTOMATIC OPERATION OF BED, COOLING BED, SHUFFLE BARS AND COLD RUN-OUT TABLE

shaped groove, into which the hot bar is delivered while in motion by a series of kick-off fingers. These fingers are driven by a motor, which is started by the motion of a trigger, placed in the path of the hot bar. This trigger is so located that as the last end of the bar passes the trigger, the latter flies back, by action of a spring, into its original location. This closes the electric circuit and starts the kick-off motor, which delivers the bar into the trough. From this point, the bar, after its longitudinal motion has stopped, is picked up by the cooling bed racks and deposited into the first notch of the cooling bed. This motion also is automatically accomplished, by means of electric control actuated by the kick-off shaft. The kick-off shaft makes one revolution for every bar delivered from the mill and is then automatically stopped. Before it reaches its stopping point, an electric contact has been established with the cooling bed motor, which, therefore, starts the motion of the cooling bed racks. The hot bar is thus lifted out of the hot run-out trough and deposited in the first notch of the cooling bed racks.

The cooling bed is 453 feet long. It consists of a series of racks, alternate ones moving in substantially opposite directions, and thus transferring the bars, which are to be cooled, successively from notch to notch. The racks are bolted to two sets of frames resting, with their bearings, on cranks of the operating shaft in the center, one side being linked to allow horizontal movement. In normal position, both sets of racks are in the same plane, their notches being in a straight line. During normal operation with the bed filled, one bar drops off the last notch for every new bar received in the first. The hot bed operator can, however, advance the bars on the cooling bed so as to leave empty notches, or can unload the bed altogether by closing a switch in the line to the hot bed motor. The cooled bars from the cooling bed racks are deposited in successive order on to the shuffle bars. When a sufficient number have accumulated, the shuffle bar mechanism is started and the bars are delivered on to the rollers of the cold run-out table. This table conveys the bars through the mill shears, where they are cut to the ordered lengths, and delivered.



MILL MOTOR WHICH DEVELOPS 1,500 HORSEPOWER

Glimpses Into the Realm of Vulcan

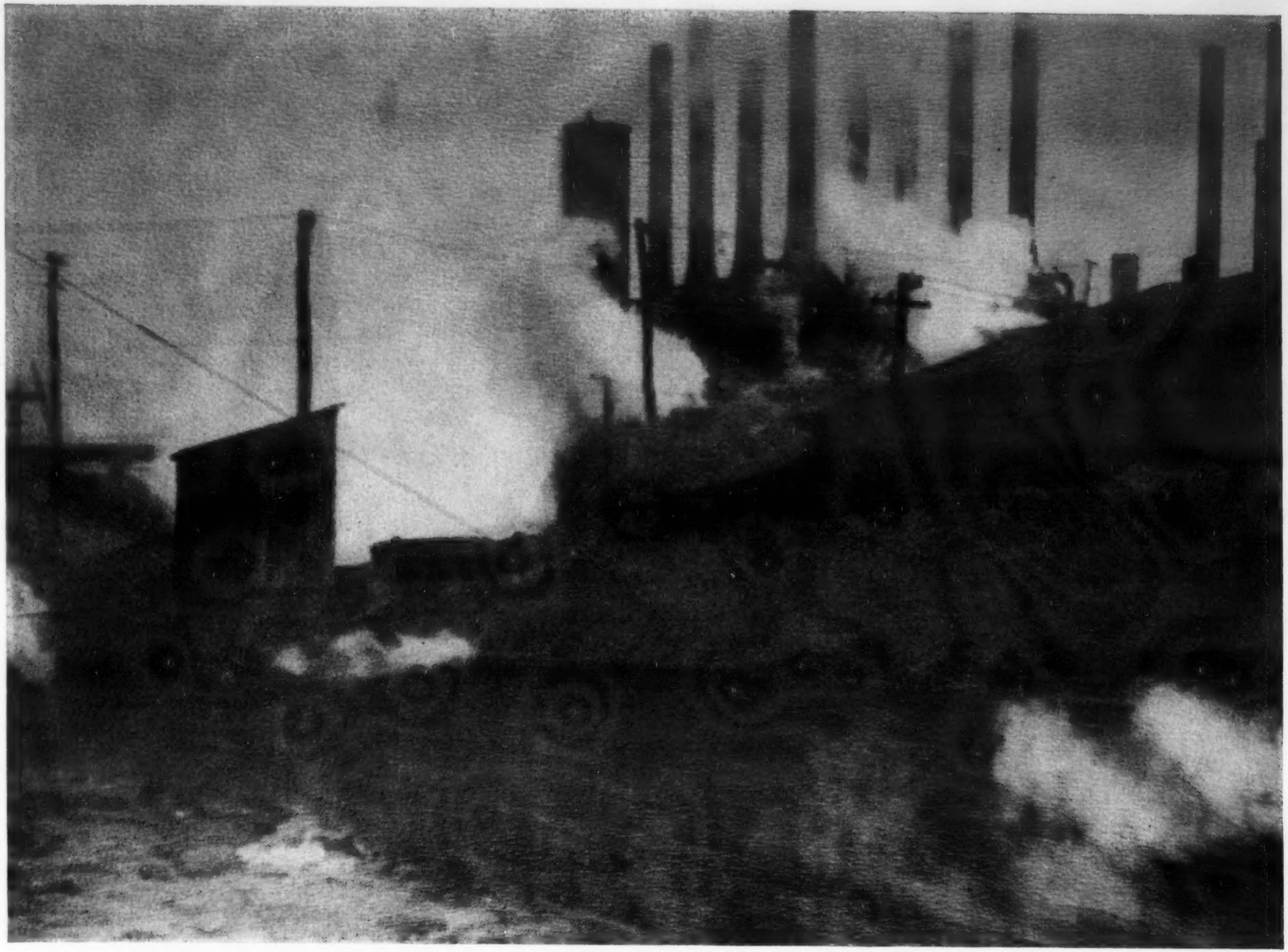
Ten pictorial impressions of characteristic phases of the American iron and steel industry.

THE ARTIST IN INDUSTRY

SEVERAL of the striking and artistically excellent illustrations reproduced on the following pages are the work of men who indulge their talent with camera or brush as a relaxation from their duties in connection with important iron and steel manufacturing interests. James Bonar, one of whose oil studies is shown, is president of James Bonar & Co., Pittsburgh. Born in Scotland, he was the first man to secure an education through the generosity of Andrew Carnegie. He began his industrial career in Pittsburgh, as a machinist in one of the Carnegie plants. Mr. Bonar is president of the Associated Artists of Pittsburgh, one of the principal organizations of its kind in this country. H. C. Torrance, examples of whose work are also reproduced, is likewise of Scotch birth. At the present time manager of the Pittsburgh office of the Brown Hoisting Machinery Co., Cleveland, he has had a varied experience in the mining and steel manufacturing fields. He is a member of the Associated Artists of Pittsburgh, the Pittsburgh Academy of Science and Art, and has exhibited in the London Salon and other famous galleries. R. L. Sleeth Jr., of the Seaman-Sleeth Co., Pittsburgh, founded his photographic reputation during the Spanish war in 1898, when many pictures taken by him at the front were reproduced in leading periodicals of the country. He filled two terms as president of the American Federation of Photographic Societies.

Courtesy of the United States Steel Corporation.

THE INSATIABLE HUNGER OF INDUSTRY—CHARGING AN ELECTRIC FURNACE

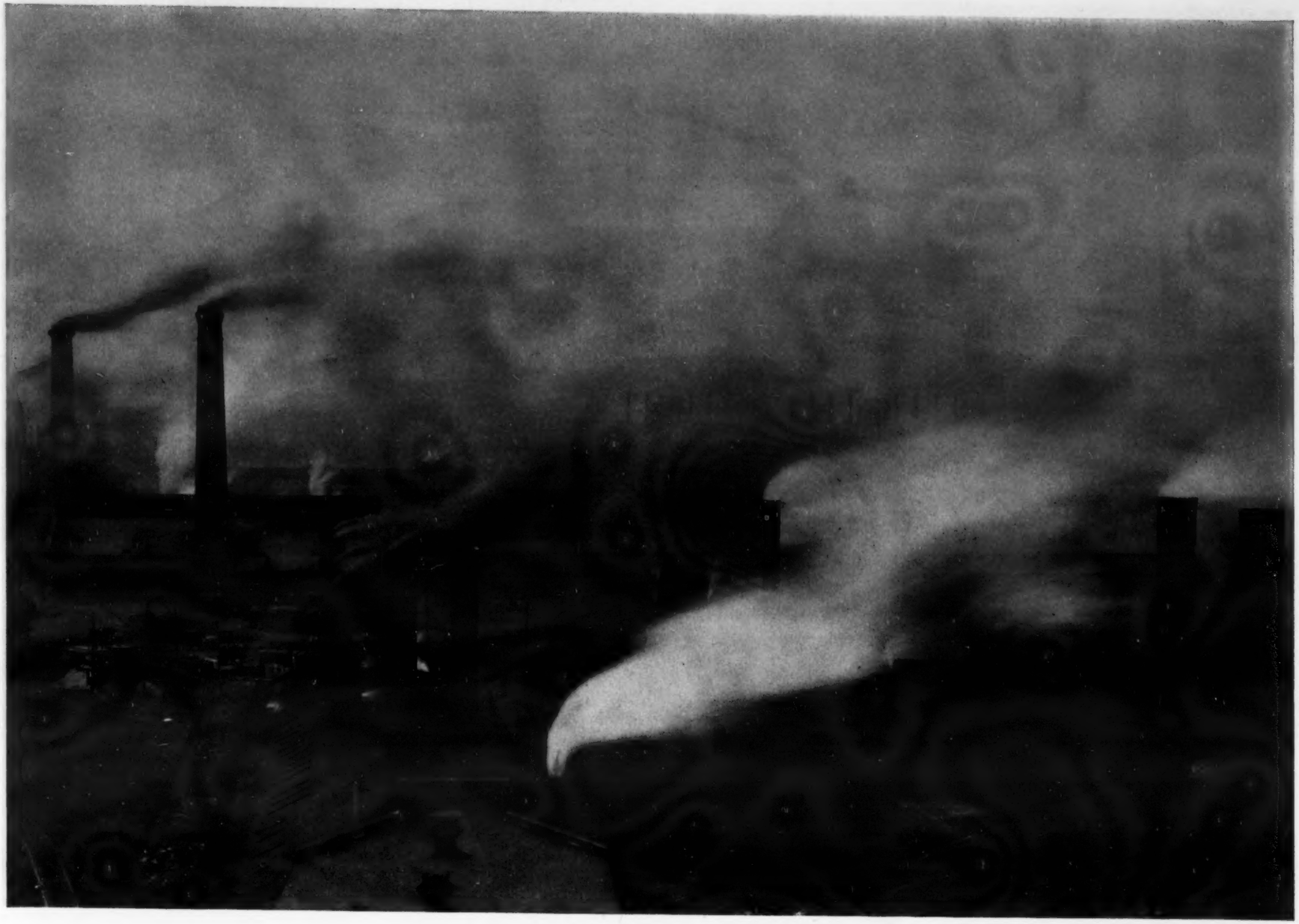


DUNBAR FURNACE, PITTSBURGH

Photographic Study by R. L. Sleeth, Jr.

THE INTRUDER
Rouse Mine, Colorado Fuel & Iron Co., in the shadow of Spanish Peak

Courtesy Colo. Fuel & Iron Industrial Bulletin



THE BICEPS OF A NATION—PITTSBURGH AT WORK

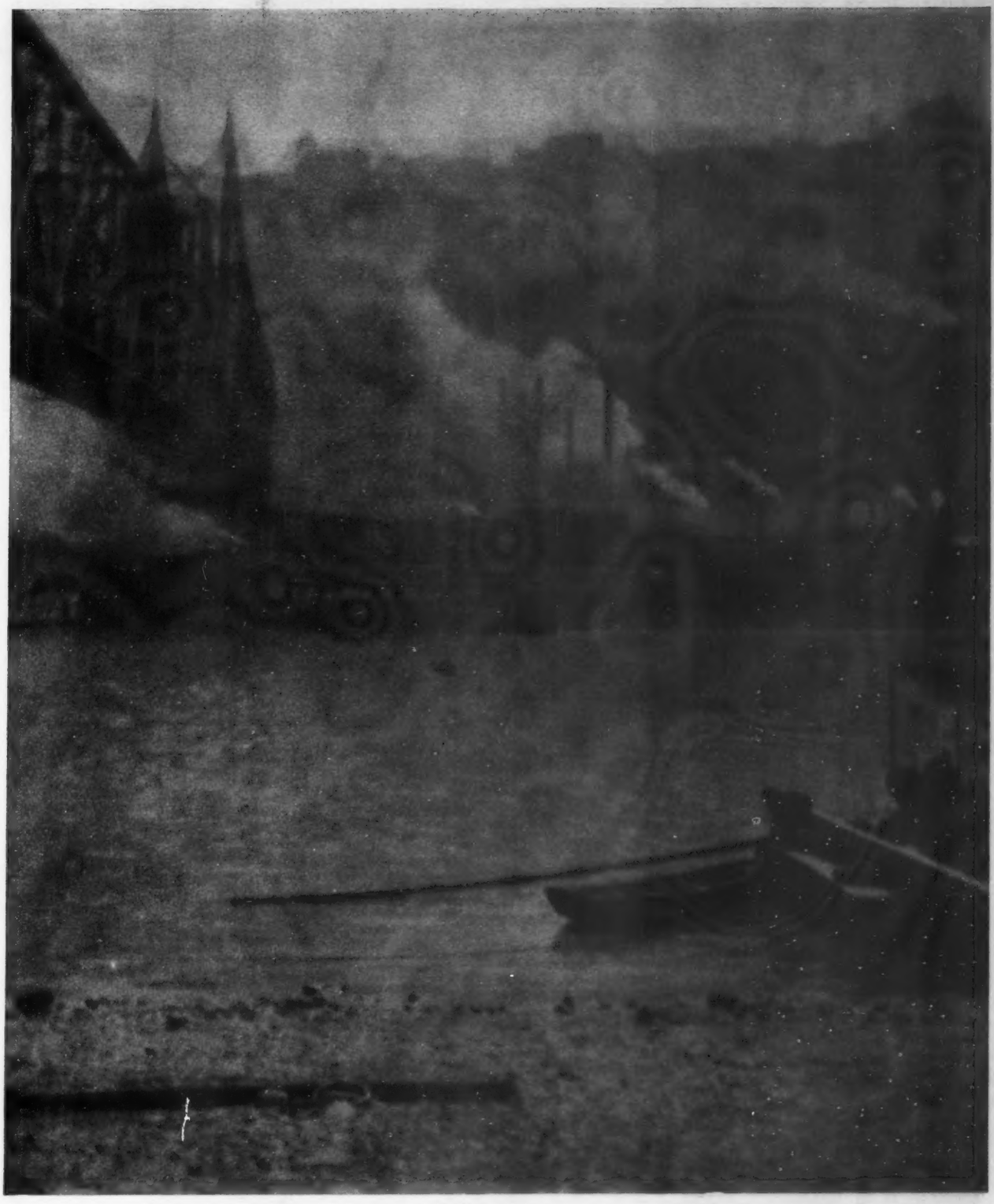
Courtesy of the United States Steel Corporation.

CLINTON FURNACE FROM WATER STREET, PITTSBURGH

From a Painting by James Bonar.

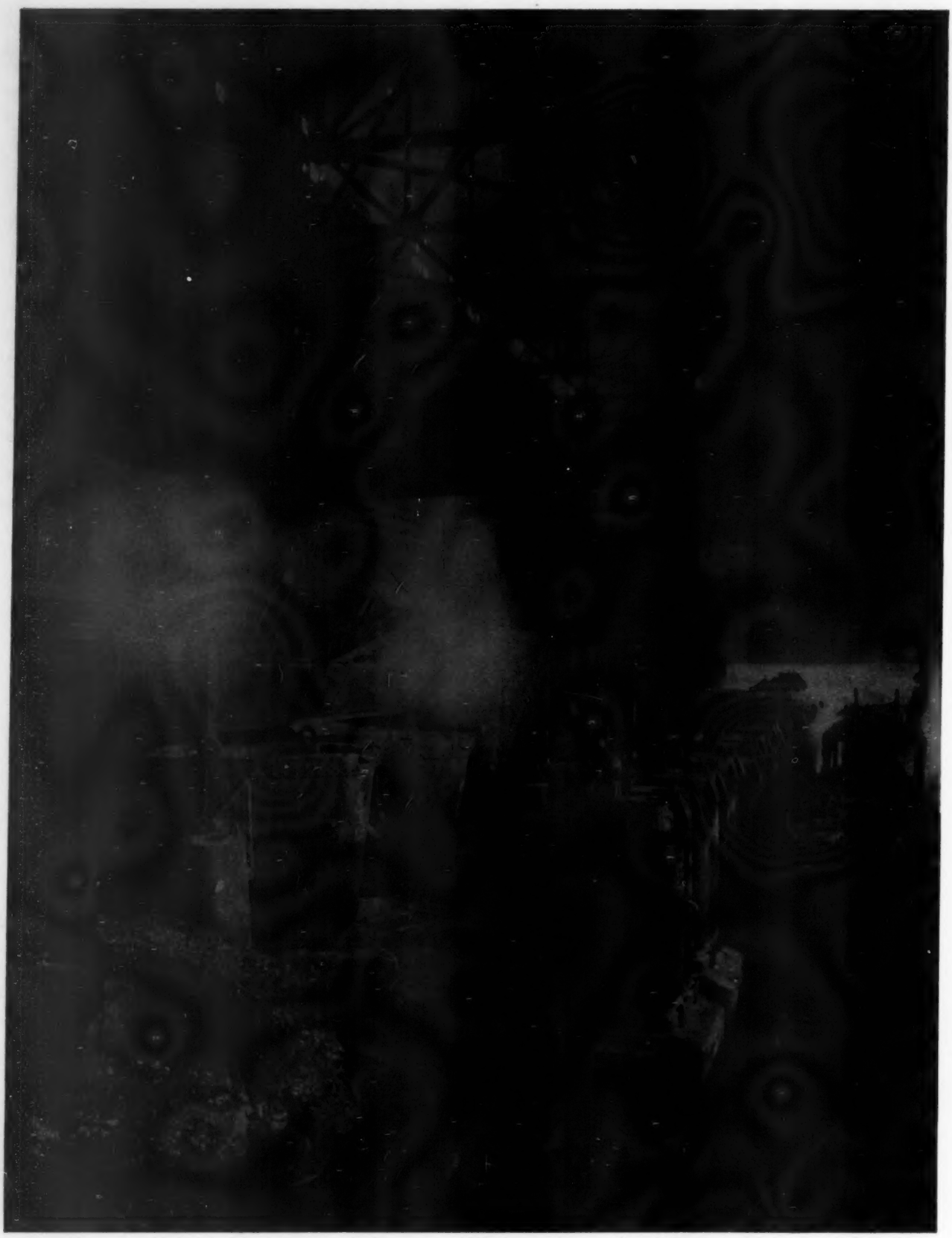
UNLOADING COAL ON THE ALLEGHENY RIVER, PITTSBURGH

Photographic Study by H. C. Torrance.



Photographic Study by H. C. Torrance.

SMELTING PIG IRON UNDER THE CLIFFS AT PITTSBURGH



A GREAT TILTING FURNACE

Courtesy of the United States Steel Corporation.

Courtesy of the United States Steel Corporation.

CASTING INGOTS

THE FIRE SERPENT—ROLLING STEEL RAILS

Courtesy of the United States Steel Corporation.

Plow Point—Rear View

Primitive Iron Smelting in the Philippine Islands

Plow Point—Front View

By J. F. Springer

THE Philippine Islands possess several deposits of iron ore in commercial quantities. One of the most important ore districts lies north of Manila, in the island of Luzon. Here, in the province of Bulacan, is a section of country 9 or 10 miles long and perhaps half as broad, through which several deposits of iron ore are scattered. Access from the south may be obtained by rail to Baliuag, then up-stream for 11 miles on the Angat river to the town of the same name and by foot trails to the ore deposits. This last part of the route lies in a region whose roughness will prohibit good roads for some time to come. The northern ore deposits may be reached by going north to Sibul and striking back in a southeasterly direction, following the valley of the Balaong river. To reach the northernmost deposit by this route involves covering a distance of 92 miles from Manila. Forty-two miles may be saved by following a more direct route through the town of Angat, but the longer route is considered preferable.

The ores consist of intimate mixtures of hematite and magnetite, deposits being usually discovered by noting boulders of ore. The outcrops are usually of hematite with but little admixture of magnetite. At a short distance below the surface one comes upon the latter mineral. At Hison and Montomorong, almost pure magnetite is mined in shallow pits. The ores of Santol and other sections, where the mining operations are conducted on the surface and consist chiefly in breaking up boulders, is mixed with but little magnetite. However, at the most northern part of the Bulacan district surface ore containing a high percentage of magnetite is obtained.

The Comaching district appears to contain the most ore. An analysis from this section, compared with those of other magnetites, is given in the following table:

	From Comaching, P. I.	From Hong Kong, China.	From Cornwall, Pa.
Moisture (212 degrees Fahr.)	0.25	....	1.11
Silica	5.02	1.20	8.65
Alumina	4.80	....	1.39
Ferric oxide	66.41	70.32	....
Ferrous oxide	20.64	22.53	....
Lime	0.35	0.60	2.74
Magnesia	0.74	3.64	3.94
Manganese oxide	0.24	1.48	....
Titanium oxide	0.23	....	....
Phosphorus pentoxide.	0.12	0.009	....
Sulphur	0.02	0.11	2.50
Carbon dioxide	1.10	....	....
Total	100.32	99.90	....

The chemical characteristics of the ores are interesting. If we except certain quartzose ore, alumina occurs in percentages relatively high as compared with the silica content. Magnesia occurs in higher percentages than lime. As to phosphorus, the greater number of the ores have a content less than the maximum bessemer percentage. Sulphur is as low as it is reasonable to expect in the pure ores. In those where it occurs as pyrite, the sulphur is high. In all ores but one titanium ore, both titanium and manganese occur in low percentages. The foregoing general statements of chemical characteristics are based on a summarization by Dohlburg and Pratt, who have investigated the district. The ore has a metallic content of approximately 60 per cent, according to Dahlburg and Pratt. An attempt to ascertain the quantity of ore in the deposits has proved difficult, there being no underground developments while a magnetic survey would yield no intelligible results. However, an estimate based on the geological conditions, as far as they are known, indicates that the most northerly deposit at Comaching contains at least 1,100,000 tons of ore. This deposit would appear to constitute nearly the whole of the aggregate deposits of the entire district. Bulacan province contains a total amount of about 1,200,000 tons of ore.

As far back as 1664, iron was mined not far from Manila. The deposits of Bulacan province began to produce not later than the last quarter of the eighteenth century. The rich region at Comaching came into notice about a century ago. Somewhat later, about 1830, European machinery was brought to Manila and an attempt made to transport it to Comaching. This effort was unsuccessful, owing to the difficulties encountered. The

IRON MINING COUNTRY IN BULACAN PROVINCE

ORE BED AT CONSTANTIA MINE, ANGAT

machinery was left scattered along the road. If we go back to the last quarter of the eighteenth century, we find that the reduction process employed in the Philippines produced the iron in the form of balls or pasty masses. From these, bolos and other forged implements were made. The first smelting process used followed Spanish lines. The methods employed at present disclose traces of Chinese influence. The Bulacan iron district had 10 furnaces in operation in 1913. Only one of these was at Comaching. Ore having an iron content as low as 50 per cent is used at some of the furnaces. Ordinarily, however, such ore is enriched by adding iron scrap. The operation of mining the ore, as it has been conducted, is primitive in the extreme. The boulders are simply broken up by means of hammers and bars. Where a pit is dug, it is quite shallow and the ore is hoisted by ordinary means.

The smelting apparatus is usually set up near the source of charcoal, as it seems to be easier to carry the ore a mile or two rather than the latter. A typical smelter, called a *camarin*, has thatched gable roof 50 feet wide and 70 feet long. Beneath it are the furnaces, a train of molds, a storeroom for the iron, a bin for charcoal, a pile of ore, a core-burning pit, an apparatus for producing a blast and sleeping quarters for the men. The train of molds is arranged around the outskirts of the smelter. The pile of ore covers a space 3 or 4 feet in diameter. The core pit is employed to bake clay cores used in plow-point molds. The man who makes the cores works near the pit, making not only cores but tuyeres and molds out of clay.

The furnaces are in the form of cylindrical stacks 7 or 8 feet high and 4 or 5 feet in diameter. Two furnaces are placed in the center of the smelter and are operated alternately. The upper part of the stack, which is hollow, forms the crucible. The shape of the chamber is that of an inverted truncated cone. The diameter varies from about 20 inches at the bottom to about 40 inches at the top. At the bottom of the crucible a rectangular hole extends from front to back. This hole or runner is 4¾ x 5¼-inches in section. On the front end a temporary bridge of clay is arranged which cuts down the section somewhat at this point. A tuyere is brought in through the rear of the runners, the front acting as a tap hole. Iron and slag are both withdrawn through this one orifice. A clay hand-ladle receives the iron as it flows from the tap hole.

The brick of which the furnace is constructed is soft burned, being made of clay residue from the decomposition of granite. The mortar is made from the same clay as the brick. A coating of clay and charcoal is put on the sides of the crucible and runner preparatory to each heat. In the front wall of the crucible above the tap hole, a special block of unusually refractory material is set in place. Its position is such that it receives the blast from the tuyere. These refractory blocks are obtained from a stratum of quartz-sandstone. The tuyere is about 2 feet long, with an external diameter of 8 inches. The internal diameter is about 2½ inches. A hollow log, set back of the tuyere and fitted with a piston, supplies the air blast. Its interior diameter is about 14 inches. The piston, which is also of wood, is fitted with a rod which permits of hand operation. Soft chicken feathers attached all around the edge of the piston serve the purpose of rings. At either end of the displacement chamber is a valve connected to the tuyere by wooden tubes, the whole providing for double action in blowing. The man who operates this device has simply to shove and pull and keep at it.

There are two parts to each clay ploughshare mold, a base and a cover. Rattan or wire is employed to hold the parts together. The base is secured rigidly to a frame or rack, the mold being tilted to an angle of 40 degrees and supported by a seat on two crotched sticks.

Formerly, Filipinos burned their charcoal in pits; in the iron regions, the kilns are now constructed of bamboo and are entirely above the surface. It is said that the bamboo kiln was originated by an Englishman half a century ago at Cupang. At any rate, it is now called an *inglesa* and has come into general use.

A rectangular space is enclosed by a wall of bamboo poles, about 15 feet high. The area enclosed is about 15 x 45 feet in size. The logs which are to be burnt are cut in lengths of 12 feet and are then piled up in the interior like cord wood. Care is taken to leave an 18-inch space all around between the pile of charcoal material and the bamboo wall. This space is filled with charcoal waste. Longitudinal draft openings are arranged along the floor of the kiln. The fire is made at one end, from which it

BLAST FURNACE FOR IRON SMELTING
SANTIAGO CAMARIN ON CONSTANTIA CLAIM CAMARIN SHOWING PISTON, TUYERES AND BLOWER

works its way gradually through the pile, the two attendants controlling it by opening vents in the walls. The process consumes 15 to 30 days. It is said that all kinds of wood are employed; that the charcoal is of fine quality; that it is hard and strong and is obtained in unusually large pieces. The mode of operating a smelting furnace is of interest. A slow fire is started and charcoal is then added and the fire kept going until the crucible is filled, a gentle blast being used. In the course of a full day of 24 hours, the blast is increased and a little ore, together with additional charcoal is put in at the top. Larger charges are added until the furnace comes into full operation. The interval between charges will depend upon the way in which the iron flows. Ordinarily it varies from one to five hours. Two shifts of men are employed. A charge of about 150 pounds includes 95 pounds of charcoal and 55 pounds of ore. Both spread evenly over the top. The pieces of ore are about 0.8-inch in diameter and smaller. Iron is withdrawn from four to 10 times per 24-hour day. The flux for the slag is supplied by the coating or lining of clay and charcoal. The tap hole is never entirely closed, a long tongue of fire shooting out at every stroke of the blast apparatus.

CAMARIN SHOWING TUYERES AND MOLDS

Plowshares and plowpoints are cast at each heat without allowing the metal to cool. Oxidation is prevented by covering the iron in the ladle with charcoal. The plowpoints are hollow. The plowshares have projecting pieces for attaching them to the plowbeam. Accordingly, the clay molds are provided with core boxes into which molding sand is pressed around several sticks, which provide, upon their withdrawal, molds for the plowshare projections. A large plowshare will weigh 7 pounds; a pair of smaller plowshares, 8.8 pounds; a still smaller pair, 5½ pounds; and a pair of plowpoints, 11 pounds. A furnace will continue in operation for 12 or 15 days. The furnace is usually put out of commission as soon as difficulties begin to manifest themselves, the other furnace of the pair being blown in. All the work is done by hand. An average production is about 550 pounds of metal per day per smelter.

In 1913, 10 furnaces were in blast, making 61 smelting runs. A total of 555 tons of ore was consumed, producing 226.7 tons of plowshares and plowpoints, with a value of $64,471.

About 960 tons of charcoal were consumed. Each furnace was in blast about 66 days during the year. The efficiency of the process as measured by the percentage of metal extracted was 68 per. cent. The 32 per cent loss is not due to the formation of a ferrous slag, but to small pieces of iron and of ore being carried off in the slag.

All Philippine iron now comes from the province of Bulacan, competing with plowshares and plowpoints made by the Chinese at Manila from imported pig iron. The amount of business done by the Chinese is larger than that of the natives, but the native product is esteemed so much better that it brings nearly twice the price. Electric reduction of ore seems to present to Dahlburg and Pratt a solution of the various commercial problems presented.

PLOWSHARE CASTING

MOLDS FOR CASTING PLOW POINTS

OBVERSE OF PLOWSHARE

ON THE DIVIDING LINE BETWEEN THE SUSQUEHANNA AND SELLERS PITS, HIBBING DISTRICT, MESABI RANGE

This Illustration Shows Very Clearly the Character of the Workings in the Greatest Iron Mining District in the World. It Will be Observed that the Boundary Lines Between the Pits are Gradually Being Swept Away.

Iron Range Developments in 1915

IN THE iron ore country, the past season was one of tremendous contrasts. The year opened with prospects of only moderate activity but closed at a record breaking pace, lake shipments continuing until ice blocked the canals and rivers. All eyes are now turned toward 1916, when it is expected 60,000,000 tons will be mined and shipped. The year just closed witnessed important developments in many directions.

By H. Cole Estep

FROM the war-riven provinces of Europe to the iron ranges of Lake Superior is a far cry, yet so sustained are the pulsations from the great conflict that no region, however remote, can wholly escape their stimulus. When the advance guard of the invading host of war-orders first reached our shores, a year or so ago, the entire iron ore district of the North lay dormant, with little hope of activity during the approaching season. Half the new year passed before any change took place. Meanwhile the struggle on the other side of the world spread with increasing fury and the stream of exports expanded rapidly. The enormous stocks of raw material accumulated during the depression of 1914 were soon absorbed and by August the demands from the firing line had penetrated to the very foundation of the iron and steel industry. As a result of the impetus thus obtained, we now find the whole iron ore country vibrant with enterprise and deeply immersed in preparations for the greatest season in the 72 years of its existence. It is extremely fortunate for all concerned that the rosy prospects for 1916 are no longer contingent upon war-orders for their fulfillment. Business begets business and in the past few months we have built up a vast domestic commerce which will tax our ore producing and carrying facilities to their utmost.

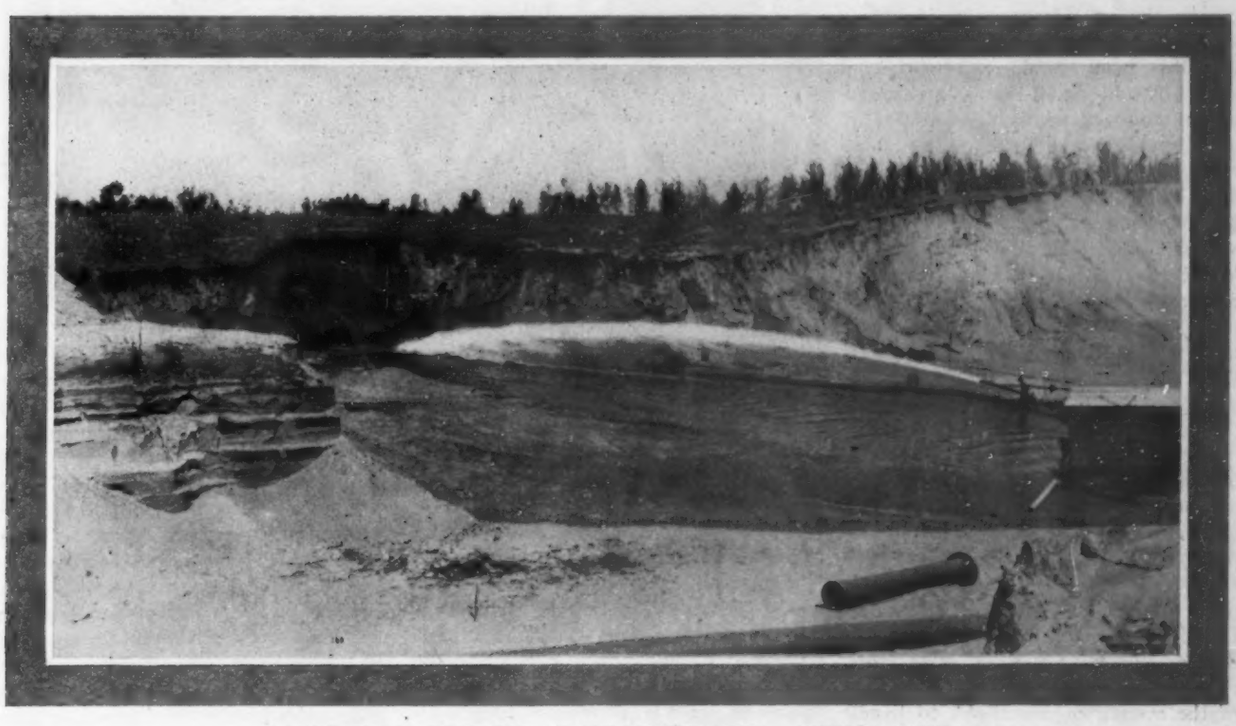
Table I.

APPROXIMATE SHIPMENTS BY RANGES

	1915.	1914.
*Mesabi	29,633,046	21,465,967
*Vermillion	1,656,465	1,016,993
*Cuyuna	1,133,643	859,404
Total Minn.	32,423,154	23,342,364
*Gogebic	5,146,772	3,568,482
*Marquette	3,785,273	2,491,857
*Menominee	4,963,605	3,221,258
Mayville, etc.	134,500	105,765
Miscl. shipments by rail	677,500	†
Total	47,130,804	32,729,726

*Includes Lake shipments only in 1915.
†Absorbed in range figures for 1914.

In our review of the iron ore situation for the year 1913, which was the banner season as far as production is concerned, it was pointed out that the removal of all of the duty on foreign ore in accordance with the terms of the Wilson-Underwood tariff act would result in bringing the imported product practically to the eastern gates of Pittsburgh. This prophecy was amply fulfilled in 1914 with unsatisfactory results to the Lake Superior operators. At the present time, due to purely temporary conditions produced by the war, we have a practically unlimited tariff on iron ore and the ensuing season undoubtedly will witness the penetration of the Lake Superior product farther toward the Atlantic seaboard than ever before. In short, the Lake Superior producers find themselves facing a wholly unexpected and purely temporary demand for large blocks of ore for eastern shipment at a time when their regular customers bid fair to take an unprecedented tonnage. This appears to be the only artificial factor in the iron ore situation for 1916; there is no doubt that the enormous requisition of lake and middle western furnaces are based on



HYDRAULIC STRIPPING AT HILLCREST MINE, CUYUNA RANGE

a thoroughly sound foundation. In our review of two years ago we also commented on the attitude of the government in regard to the ownership of iron ore properties and the excessive concentration of valuable natural resources in a few hands. It was stated that the government's influence had led to great changes in the distribution of ore holdings and undoubtedly was largely responsible for the cancellation of the Hill lease by the United States Steel Corporation. In following out this line of thought in the light of developments during the past two years, it is exceedingly interesting to note that the so-called small producers have been unusually active and that a large number of new independent properties of considerable magnitude and value have been developed, particularly on the Cuyuna, Menominee and western Mesabi ranges. We would hesitate to state that this development followed as a corollary from the government's stand on the integration of iron ore holdings but the facts, nevertheless, are plain.

SUSQUEHANNA MINE AT HIBBING—ONE OF THE DEEPEST PITS ON THE MINNESOTA RANGES

SELLERS PIT, COEXTENSIVE WITH THE HULL-RUST MINE, HIBBING

The Year Ahead

With the pendulum now swinging back toward prosperity, the iron mining industry is keenly interested in the prospects for the year ahead. A general survey of the situation indicates that sufficient ore has been uncovered and developed both in the open pits and underground properties to take care of any possible furnace demand during 1916. Furthermore, there is little question of the ability of the mining organizations to handle anything up to 75,000,000 or possibly 80,000,000 tons. The only factor which would affect the output, from the mining standpoint, is the labor situation which may possibly become stringent. This feature will be discussed more in detail later.

To determine the maximum amount of ore which could be shipped next year, we must turn to the transportation end of the business. Here is the neck of the bottle, and on account of limitations in the capacity of the fleet it is expected that the total movement for 1916 will range between 55,000,000 and 60,000,000 tons. On January 1, 1915, there were 546 bulk freighters on the Great Lakes with an aggregate gross tonnage of 3,066,423. There were no bulk freighters suitable for carrying iron ore launched during the past season; on the other hand four total losses were reported, reducing the available tonnage by 7,227. Therefore, there were 542 bulk freighters available on the Great Lakes on Jan. 1, 1916, with an aggregate gross tonnage of 3,059,296. These calculations exclude the steamer W. F. WHITE, launched last summer by the American Shipbuilding Co., inasmuch as her special equipment precludes the possibility of her being used in the ore trade. On Dec. 1, 1915, five 12,000-ton bulk freighters and two smaller vessels of the same type were under construction at Great Lakes yards. These ships will be delivered at varying periods during the ensuing season. They will add moderately to the carrying capacity of the fleet, particularly after the middle of the year. We cannot look for large additions to Great Lake tonnage, however, until the season of 1917.

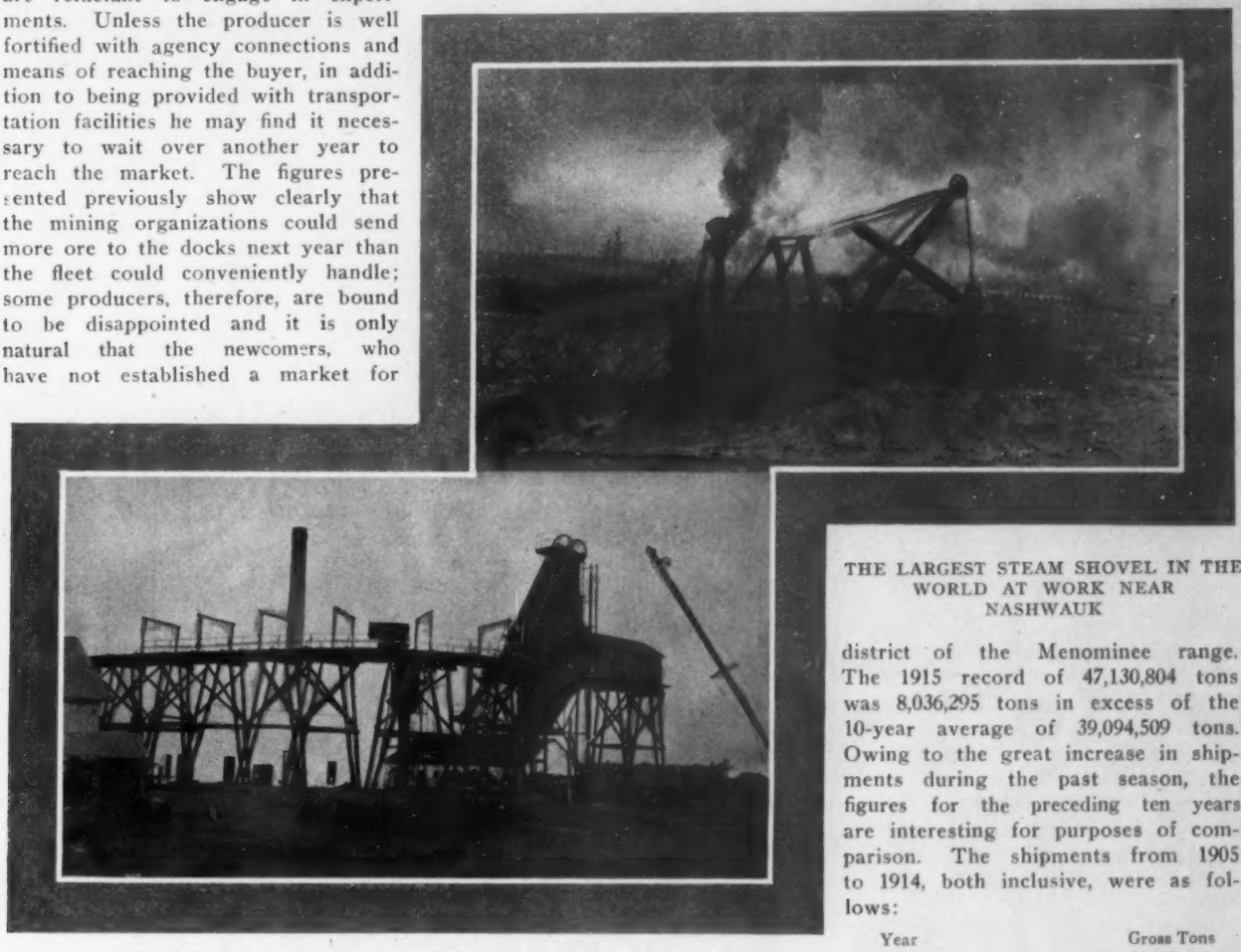
Vessel Tonnage Available

Furthermore, it should be remembered that the entire fleet of 542 bulk freighters will not be available for the iron ore traffic. A considerable number of vessels will be needed for carrying grain, of which over 261,848,332 bushels were handled through the Soo canals during 1915. The movement next year may be even larger. Also many of the coal boats, owing to their relatively small size and out-of-date construction are not satisfactory for the ore trade. The coal fleet moved over 13,035,225 tons of coal westbound to the head of the lakes in 1915. In 1913, the record year, coal and grain accounted for 45,059,539 tons out of a total movement of 100,018,464 tons.

The foregoing figures make evident the limitations of the ore carrying fleet and account for the abnormally high prices now demanded by the few remaining wild vessels. Although the 1916 charter market has been fixed at 50 cents net to the ship from the head of the lakes, an advance of 10 cents over 1915 figures, independent interests who attempted to engage additional vessel tonnage after Dec. 1, were forced to bid as high as $1.40. This figure is known to

have been asked on a proposed contract of 100,000 tons from Superior to Lake Erie docks.

The unprecedented conditions surrounding the iron ore trade at present have created a situation which may prevent some of the new independent properties that expect to ship for the first time next year from disposing of their output satisfactorily, in spite of the strong demand which undoubtedly will exist at lower lake points. It is more or less of a task to introduce any new ore, owing to the fact that furnacemen are reluctant to engage in experiments. Unless the producer is well fortified with agency connections and means of reaching the buyer, in addition to being provided with transportation facilities he may find it necessary to wait over another year to reach the market. The figures presented previously show clearly that the mining organizations could send more ore to the docks next year than the fleet could conveniently handle; some producers, therefore, are bound to be disappointed and it is only natural that the newcomers, who have not established a market for their product, will have the most difficulty.



HEADFRAME AND SURFACE DEVELOPMENTS AT CROFT MINE, CUYUNA RANGE

As indicated in Table I, it is estimated that iron ore shipments during the season recently closed aggregated 47,130,804 gross tons, compared with 32,729,726 tons in 1914. The increase, 14,401,078 tons, brings the 1915 shipments to within 2,816,312 tons of the record movement in 1913. Our estimates indicate that 1915 shipments showed a growth of over 44 per cent compared with the previous year. No more positive evidence of the ability of the iron ore industry to cope with sudden and unexpected increases in demand could be presented. The remarkable situation existing last year is clearly indicated by the statistics of ore handled on the lakes by months. The figures for 1914 and 1915 are as follows:

	Gross Tons	
	1915	1914
April	503,832	269,686
May	5,012,359	3,852,063
June	6,009,091	5,502,367
July	7,204,021	5,784,514
August	8,081,117	5,869,477
September	7,863,146	5,431,307
October	7,146,873	4,242,392
November	4,445,129	1,068,680
December	57,236	1,411
Total	46,318,804	32,021,897

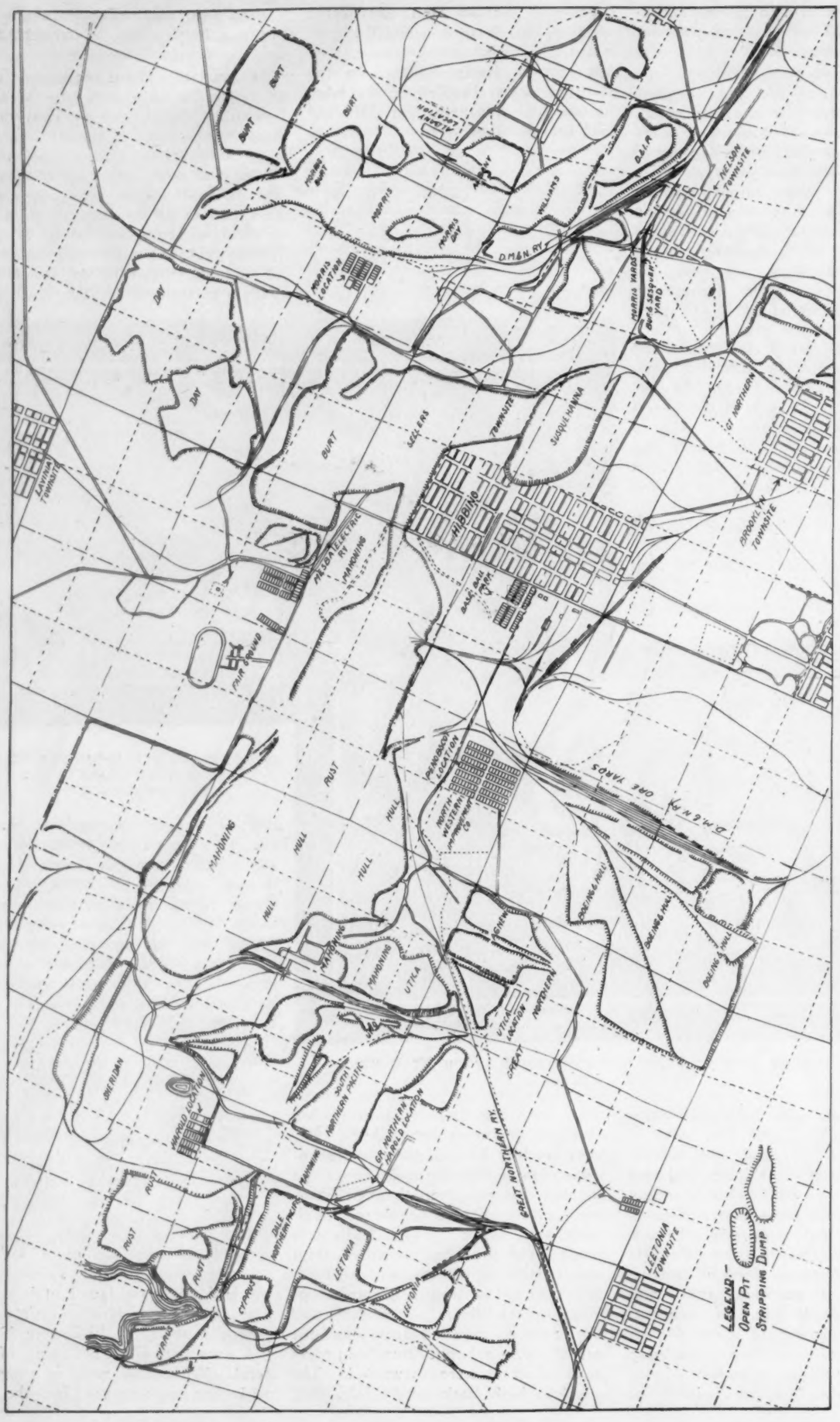
The foregoing table indicates that although shipments during April, 1915, were double those in the corresponding month of 1914, the ratio diminished in May and the strength of the season's movement did not become evident until August. The finish was particularly strong, November shipments showing an increase of fourfold over 1914. During the month of August, conditions were ideal and the record for shipments in one month was all but smashed when 8,081,117 tons were forwarded. The previous high mark, set in July, 1913, was 8,204,416 tons. The difference in the two high points is only 123,299 tons.

As usual the Minnesota ranges led all others in shipments, the Mesabi forwarding 29,633,046 tons; total shipments from all Minnesota ranges were 32,423,154 tons, or 69 per cent of the total shipments from all ranges. The Mesabi shipments taken alone amounted to 63 per cent of the total in 1915 as compared with 67 per cent in 1914. This indicates the effect of new developments on the lower ranges, particularly in the Mastodon district of the Menominee range. The 1915 record of 47,130,804 tons was 8,036,295 tons in excess of the 10-year average of 39,094,509 tons. Owing to the great increase in shipments during the past season, the figures for the preceding ten years are interesting for purposes of comparison. The shipments from 1905 to 1914, both inclusive, were as follows:

THE LARGEST STEAM SHOVEL IN THE WORLD AT WORK NEAR NASHWAUK

Year	Gross Tons
1914	32,729,726
1913	49,947,116
1912	48,221,546
1911	32,793,130
1910	43,435,171
1909	42,586,869
1908	26,014,987
1907	42,266,668
1906	38,565,762
1905	34,384,116
Total	390,945,091

The Steel Corporation's shipments showed no evidence of a lack of tonnage owing to the surrender of the Hill mines on Jan. 1 of last year. The Oliver Iron Mining Co.'s aggregate shipments for 1915 were 22,290,014 tons, or 47.44 per cent of the total. When this ratio is compared with the percentages for the two

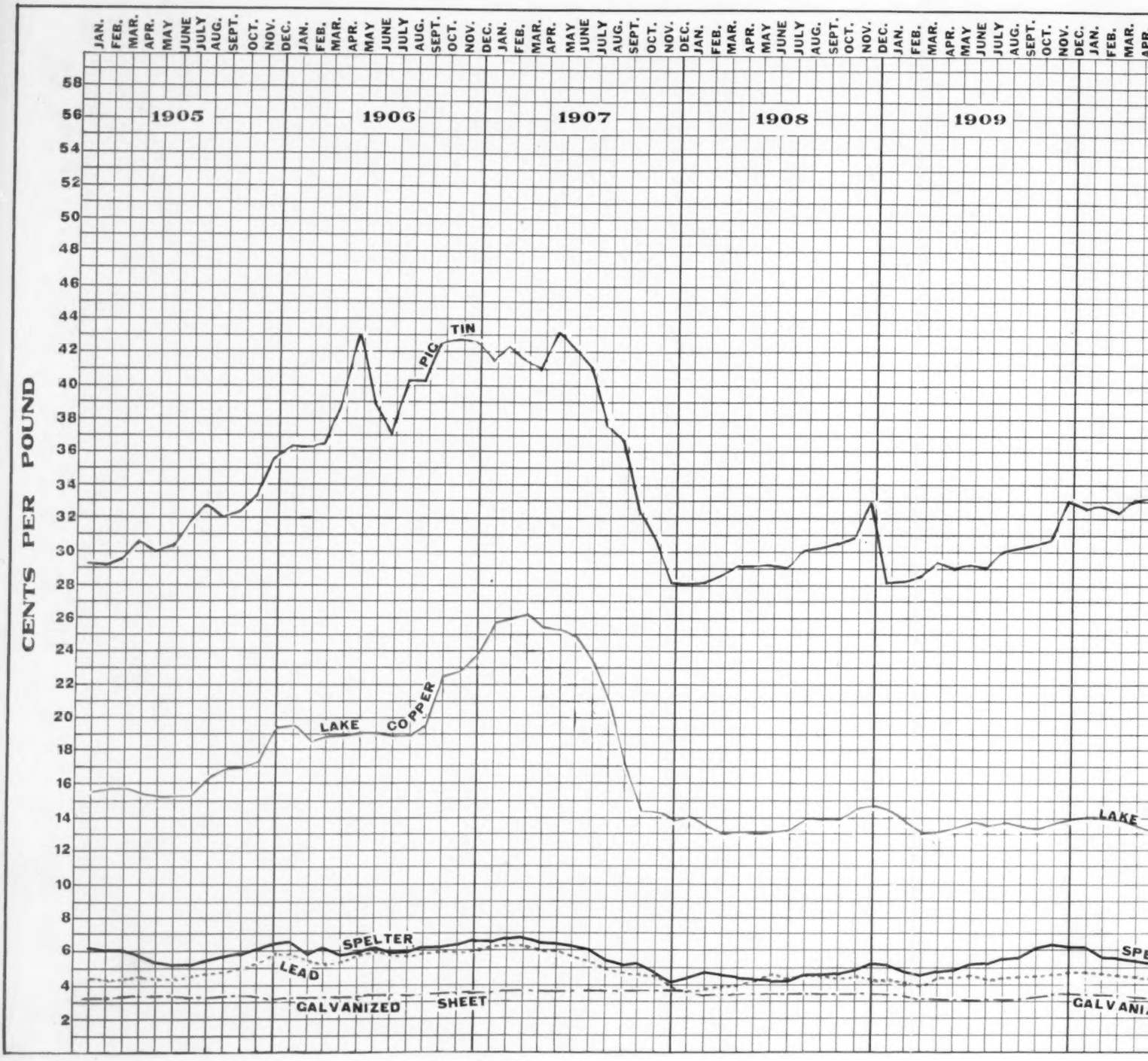


MAP SHOWING DETAILS OF OPEN PIT DEVELOPMENTS IN HIBBING DISTRICT, MESABI RANGE

This map shows clearly the size, contour and general arrangement of the open pit workings surrounding Hibbing. It will be noticed that many of the mines overlap and before many years the entire region may be converted into one tremendous open pit. The village of Hibbing is now surrounded by mines on three sides, the pits coming to the very edge of the town on the north, east and west.

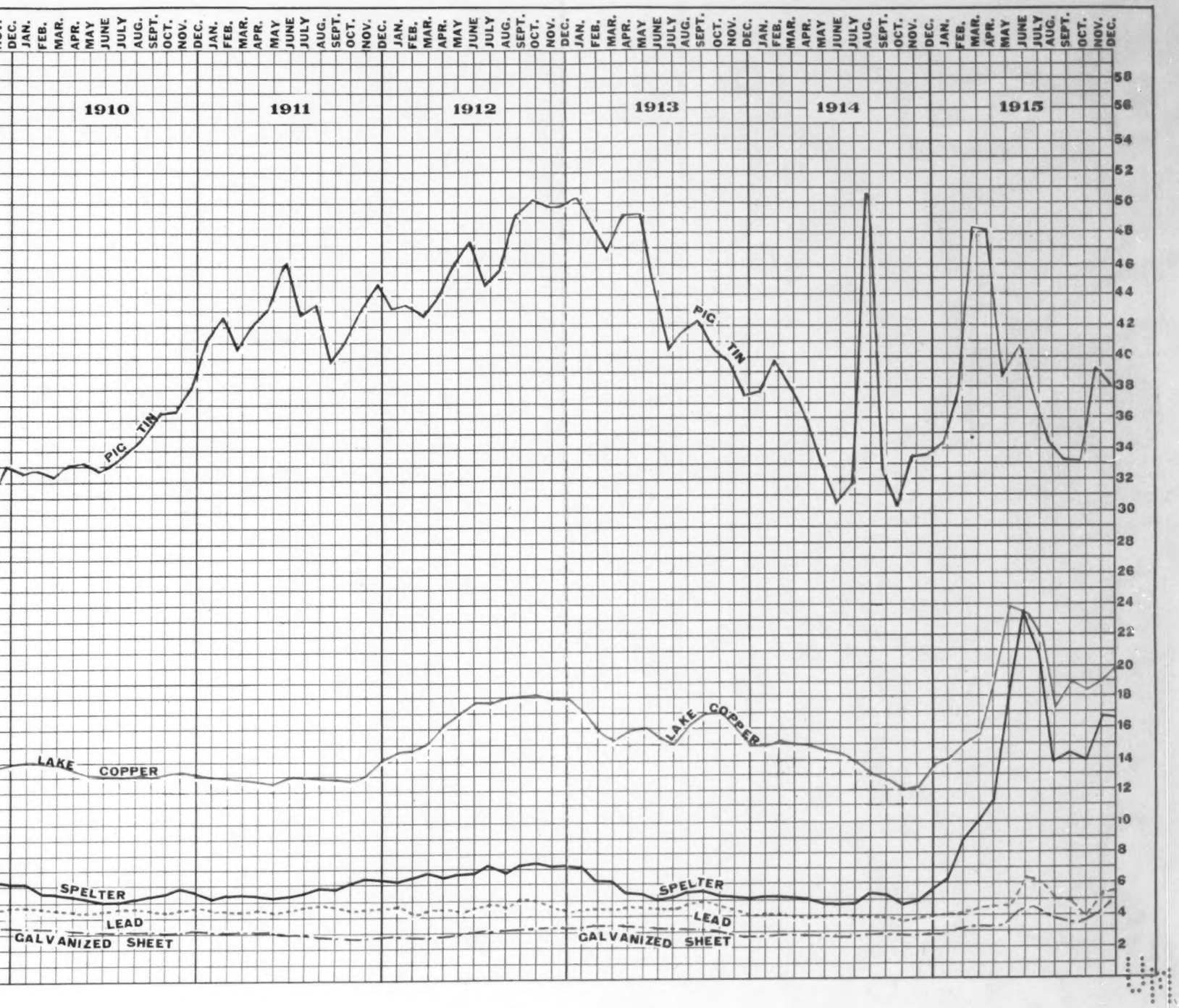
THE IRON TR

CHART SHOWING FLUCTUATIONS IN PRICES OF PIG TIN, LAKE



TRADE REVIEW

LAKE COPPER, SPELTER, LEAD AND GALVANIZED SHEETS, 1905-1915



preceding years, 49.01 and 49.06 per cent, respectively, for 1914 and 1913, the relatively more rapid growth of the independent interests becomes clearly evident. In fact the percentage of the Steel Corporation shipments has declined steadily, with one exception, since 1908, when it stood at 56 per cent. The Oliver company's 1915 shipments from the Mesabi range were 17,394,502 tons. This is 53.75 per cent of the total Minnesota shipments, as compared with 61 per cent in 1914. In other words, although the Steel Corporation was hard hit by the depression of 1914, it was able to maintain its operations on a somewhat better scale than its competitors and their recovery, therefore, has been relatively greater.

Missabe Road Gains

The effect of the cancellation of the Hill lease on the transportation of iron ore between the Mesabi range and the docks at the head of the lakes is very clearly indicated by the figures of dock shipments for 1915. During the past season the Duluth, Missabe & Northern railroad, once more regained first place, which had been held by the Great Northern for some time. This shift in transportation arrangements was commented on in our review last year. The Missabe road's shipments in 1915 were 16,437,419 tons. In other words, the principal Steel Corporation line handled 52.2 per cent of all Mesabi range shipments and 33.33 per cent of all lake shipments during 1915. The Great Northern last year handled 7,209,150 tons over its docks at Superior, this being 15.56 per cent of all lake shipments as compared with 32.63 per cent handled by the Great Northern in 1914. As was suggested in our review last year, it will be some time before the properties held by the Great Northern ore trustees are developed to the point where the Hill road will be able to regain the premier position among the ore carriers. As in former years, the Hibbing district on the Mesabi range forwarded more ore than any other iron producing territory in the Lake Superior region, its shipments for 1915 being in the neighborhood of 10,000,000 tons, of which 5,277,990 tons were forwarded by the Oliver Iron Mining Co.

For the past two seasons, the Hull-Rust mine at Hibbing has yielded the place of premier shipper to the Mahoning. In 1915 the Hull-Rust forwarded 2,294,405 tons and the Mahoning 2,311,923 tons. The record of the Mahoning mine for the past ten years is truly remarkable both for quantity of ore forwarded and quality. The shipment record of this great property since 1906 is as follows:

Year	Gross Tons
1915	2,311,923
1914	1,212,287
1913	1,515,428
1912	1,518,643
1911	1,011,945
1910	1,515,723
1909	1,561,893
1908	611,592
1907	1,564,332
1906	1,274,232

It will be noted that the Mahoning nearly doubled its average shipments last year.

Among the many problems which the mine operators will face during the ensuing season, that of an adequate supply of labor is particularly important. During the winter of 1914-15, organizations were pared down to the absolute minimum. Since that time they have been built up to full strength, but with an increasing demand for labor in other sections of the country it now seems quite certain that there will be no surplus on the iron ranges next year. At the present time, with the open pits out of the running, the supply of common labor is just about equal to the demand. The trend of wages already indicates what may happen in the future. Everyone in the Minnesota iron ore country is now paying $2.25 per ten-hour day for common surface labor; during the recent depression only the Steel Corporation maintained this figure, independent operators scaling down their payments to as low as $1.75. Common labor underground is now receiving the standard scale of $2.40 and the average rate for miners is about $3.00. The labor situation also is reflected in the prices for mine timbers which have advanced about ¾-cent per linear foot in the past year. Independent operators recently made contracts on the Mesabi range for mine timber at 4¼ cents per foot as compared with 3½ cents a year ago. Other contracts were made by the leading interest at 4½ cents a foot.

War's Effect on Labor

At the outbreak of the war, there was considerable fear in the iron ore country that the exodus of foreigners to join the armies in their native lands might prove embarrassing. There is now nothing to indicate that there was any foundation for this anxiety; it is evident that the great bulk of the unnaturalized foreign laborers in the United States are well content to remain at their work in peace and security. Nationality statistics recently compiled by the Oliver Iron Mining Co. indicate that on the Mesabi range about 56 per cent of its employes are Austrians; approximately 14 per cent are Finns, and 11.5 per cent Italians. Only about 10 per cent are Americans and the most of these occupy clerical or supervisory positions of some sort. In a typical district employing a thousand men, 17 nationalities are recognized. In this same district about 300 of the thousand odd employes are voters and about 250 more

Table III.

ORE RESERVES IN GROUND IN MINNESOTA
As of May 1, 1914-15.

Range.	1914.	1915.
Mesabi	1,386,093,626	1,382,644,910
Vermillion	11,373,349	10,209,902
Cuyuna	70,857,865	72,215,605
Total	1,468,324,840	1,465,070,417

Table II.

SHIPMENTS BY PORTS AND RAILWAYS

	1915. Gross tons.	1914. Gross tons.
C. & N. W., Escanaba	4,060,728	2,887,132
C. & N. W., Ashland	4,134,000	2,605,275
C. M. & St. P., Escanaba	1,588,561	777,319
D. S. S. & A., Marquette	949,415	479,950
L. S. & I., Marquette	2,150,174	1,275,776
M. St. P. & S. Ste. M., Ashland	1,012,772	758,144
M. St. P. & S. Ste. M., Superior	960,595	721,662
N. P., Superior	173,048	137,564
G. N., Superior	7,209,150	10,450,522
D. M. & N., Duluth	15,437,419	6,318,291
D. & I. R., Two Harbors	8,642,942	5,610,262
Totals	46,318,804	32,021,897

have taken out their first naturalization papers. Over half of them, therefore, are well on the way toward citizenship. About 90 out of the 1,000, it is stated, are entitled to take out their naturalization papers but have not done so. There may be a shortage of labor on the iron ranges next year, but it is now evident that the men available will work more efficiently. This is due to an unexpected and exceedingly interesting development connected with the liquor problem. For a number of years the leading mining companies, realizing that safety, efficiency and booze do not fit well together, have been discouraging the consumption of intoxicating liquors. Last year they received powerful aid from the federal government, with the result that air-tight prohibition now prevails in all of the iron ore country in Minnesota except the Vermillion range and that portion of the Mesabi range lying east of

MINER SUBJECTING OXYGEN APPARATUS TO SMUDGE TEST

MINER EQUIPPED WITH OXYGEN HELMET FOR RESCUE WORK

Buhl. In other words the entire Cuyuna range and the centers of population and activity on the Mesabi range are completely dry. The entire dry territory includes portions of several counties in northwestern Minnesota, embracing an area larger than the state of New Jersey, with an extensive foreign born industrial population.

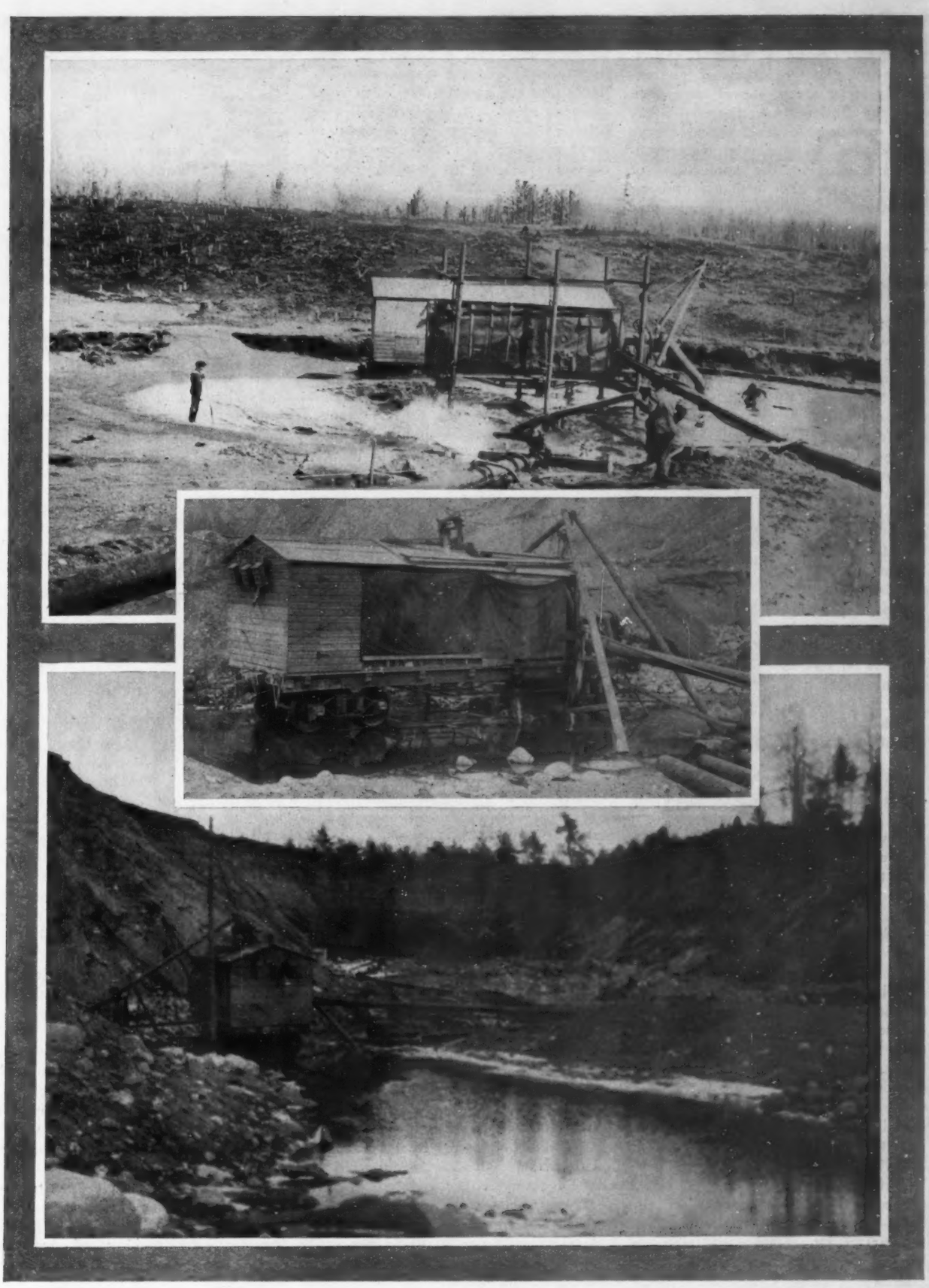
The present situation is the culmination of a peculiar chain of circumstances. In 1856 the United States government made a treaty with the Chippewa Indians living in northern Minnesota covering the disposition of their lands and the relations between the government and the tribe. Among other stipulations, the treaty contained a clause making it unlawful to keep any intoxicating liquor within a certain specified territory. This territory now embraces those portions of the iron ore country mentioned above. For a great many years the treaty was nothing more than a forgotten scrap of paper. Recently, however, it was resurrected and has successfully withstood legal bombardment of every character. The United States courts declared the treaty perfectly good and ordered all liquor within the specified territory destroyed forthwith.

Acting upon orders of the court, Indian agents of the United States government passed through the affected territory on Dec. 1 and not only closed every saloon, but destroyed all remaining stocks of liquor. The saloons on the Cuyuna range had been similarly closed some months previous.

The interesting feature of the treaty lies in its provision for absolutely complete prohibition; no liquor is to be allowed within the specified territory, even on the persons of individuals. There is every indication that the government officials mean business and there will be no laxity in enforcing the provisions of the treaty. In view of these conditions, a review of the situation six months hence would be exceedingly interesting. Up to date, although there has been grumbling from certain quarters, the heads of the mining organizations are unanimously agreed that the prohibition order will have a very salutary effect upon the labor situation and will materially improve living conditions on the iron range. The government's action has met with almost universal approbation. The government is also manifesting its interest in the labor situation in another manner. Recently one of the several mine rescue and first aid instruction cars operated by the bureau of mines, department of the interior, has toured the Mesabi range for the purpose of teaching selected groups of miners the principles of first aid work. Squads were organized by the mining companies at each of the points visited by the car and the men selected were rigorously trained in

THE ONE MAN CARRY

the use of oxygen breathing apparatus and other features of rescue work. Moving pictures dealing with safety problems in mining also were shown by the officials in charge of the first aid car. Turning now to the technical problems connected with iron mining, we



OPERATIONS AT THE HILLCREST MINE ON THE CUYUNA RANGE

The top view shows the commencement of stripping operations. The rapidity of the work is clearly illustrated by the lower view showing the condition of the pit a few weeks after the work was started. The small inset in the center of the page shows the sand pump mounted on a flat car.

find that there were a number of interesting developments during the past year. Some significant experiments on the operation of an unusually large steam shovel have been made by Butler Bros.; there also has been considerable development in the methods of washing and concentrating ores and in the application of electric power to ordinary mining operations. Considerable study has been given the problems of rock separation in open pit work. The season just closed also witnessed progress in the development of underground loading machines and small gasoline driven auxiliary hoisting apparatus.

For stripping the Mace Annex mine, a Longyear-Bennett open-pit property near Nashwauk, Butler Bros. are utilizing one of the largest steam shovels ever constructed. It is of the revolving type and is illustrated on page 83. The machine was furnished by the Bucyrus Co., So. Milwaukee, and has a net weight of about 325 tons and a gross weight of approximately 400 tons. The boom is 60 feet in length; the mast is 85 feet long, and the machine is designed to cast up to a height of 60 feet. It takes out a cut about 150 feet in width; in fact when working under a 40-foot bank the total width of the cut at the top is said to be 200 feet. The machine is reversible and therefore does not have to be moved after it has finished any given cut. It simply turns around and goes back. This shovel undoubtedly effects considerable savings in labor, particularly in view of the fact that it requires only two pit men. A gang of from four to six is employed in connection with an ordinary shovel. This shovel is provided with a six-yard dipper and it is said it can load 125 twenty-yard cars in a ten-hour shift. Its cost is about $35,000, compared with approximately $10,000 for a machine of ordinary size. The performance of this great machine evidently has been satisfactory to its owners who are installing a similar one on the lower ranges.

STOCKPILE AT JUDSON MINE, MENOMINEE RANGE

Another interesting steam shovel development is found on the Cuyuna range where the Hill Mines Co. expects to use a 1½-yard revolving Marion machine for loading cars in an open pit. This mine was stripped hydraulically and the management believes that the small shovel, due to its superior speed and mobility, will give fully as satisfactory an account of itself as the larger and heavier machine.

The results obtained from the washing plants which now have been in operation on the western Mesabi for several seasons indicate that the ore in this district is easier to concentrate than was originally anticipated. Also it has been found that the recovery is greater than was considered practicable at first and that the material can be handled faster. There are now five washing plants in operation on the western Mesabi and two have been built on the Cuyuna range. The experiments which M. A. Hanna & Co. have been pursuing at the LaRue mine are surrounded with more than usual interest. Reference to this plant was made in our review last year. During the season of 1915, 25,000 tons of LaRue ore were put through the experimental washer, after which the plant was shut down in order to effect certain changes which were found necessary. It is believed that the problems of washing ore with a Weatherbee concentrator have now been successfully solved and that little difficulty will be experienced next season when it is expected to handle about 300,000 tons.

The experimental runs so far made indicate that the recovery in iron units ranges from 80 to 85 per cent. This plant is designed specially to use minimum quantity of water and it is said that 200 gallons per ton are all that is required. Following is a table showing analyses of the raw ore and the resulting concentrate:

Constituent	Per Cent—Raw Ore	Per Cent—Concentrate
Iron	51.50	59.14
Phosphorus	0.026	0.037
Manganese	0.42	0.50
Silica	22.10	9.44
Water	12.00	8.50
Extraction	88.60	iron units
Yield	80.96	by weight

It is understood that some interesting experiments have been conducted at the school of mines, University of Minnesota, on a magnetic washing apparatus for handling the magnetite ores which are said to occur on the eastern end of the Mesabi range. This apparatus, we are informed, is in the incipient stages of its development.

The use of electric power for pumping, hoisting and other mining operations is making steady progress on the Minnesota ranges, although the developments as yet are not comparable with the extensive installations of the Cleveland-Cliffs Iron Co. on the Marquette range. The Arthur Iron Mining Co., a subsidiary of the Great Northern Ore Trustees, expects to operate its newest mine, the Alexandria, near Chisholm, entirely with electricity. The energy will be purchased from a local public service company affiliated with the Great Northern Power Co., of Duluth. The latter concern's transmission lines now reach several points on the Mesabi range, although the amount of hydro-electric power so far developed is insufficient to permit of extensive operations. The Cuyuna Range Power Co. furnishes current to several properties in the vicinity of Crosby and Ironton. This also is a hydro-electric proposition and up to date the installed capacity amounts to 1,800 kilowatts. The drift toward the more extensive use of electric power is persistent from season to season.

Some of the open-pit operators on the Mesabi range, whose workings are becoming well developed are finding that the problem of separating streaks of rock from the ore is becoming increasingly important. When patches of rock are encountered the mine operators, as a rule, would prefer to take them out, together with

TABLE IV.

Shipments From Principal Minnesota Mines in 1914-15

These figures are preliminary and approximate and are presented in advance of the complete, corrected figures which will appear in a later issue of *The Iron Trade Review*.

Mesabi Range.

Oliver Iron Mining Co.

Mine.	1915. Gross Tons.	1914. Gross Tons.
Adams District:		
Adams	902,433	286,522
Leonidas	732,777	232,416
Spruce	623,577	488,870
Norman	250,695	261,062
Minnewas	33,478	5,798
Biwabik District:		
Graham	358,396	229,940
Vivian	49,456	14,993
Weed	73,670	.....
Fayal District:		
Fayal	774,150	673,643
Genoa-Sparta	426,559	476,972
Hibbing District:		
Hull-Rust	2,294,405	458,468
Burt-Pool-Day	1,043,607	213,433
Morris	1,167,421	365
Sellers	721,908	.....
Winifred	41,489	10,449
Philbin	9,160	.....
Chisholm District:		
Clark	411,442	392,530
Chisholm	468,680	399,500
Myers	216,129	.....
Leonard-Burt	324,634	21,190
Leonard-Glen	66,327	2,135
Glen	253,339	.....
Duncan	5,152	5,177
Chester	6,150	.....
Virginia District:		
Alpena	1,455,833	1,131,255
Missabe Mountain	668,660	5,347
Prindle	24,100	12,392
Wanless	46,668	3,808
Deacon	59,925	87
Lone Jack	21,560	.....
Shiras	41,785	5,206
Sullivan	20,063	.....
Canisteo District:		
Canisteo	1,622,182	1,051,895
Holman	845,898	497,276
Judd	334,685	95,416
Hill	998,649	592,590

Pickands, Mather & Co.

Elba	225,453	147,796
Minorca	116,591	85,541
Mohawk	69,318	35,050
Scranton	18,698	20,205
Hudson	196,952	127,526
Adriatic	33,625	74,911
Belgrade	212,335	155,012
Bangor	294,346	91,189
Corsica	160,655	99,613
Albany	317,030	227,766
Cyprus	25,566	45,205
Utica	356,355	247,714

Tod-Stambaugh Co.

Biwabik	385,389	255,255
Ruddy	50,002	15,215
Morton	58,214	339
Dean	360,372	.....
Itasca	126,002	.....

Corrigan-McKinney & Co.

Stevenson	8,585	89,899
Commodore	561,438	372,796

Interstate Iron Co.

Mine.	1915. Gross Tons.	1914. Gross Tons.
Meadow	41,181	38,750
Fowler	.....	12,364
Lincoln	239,141	207,251
Grant	189,748	111,443
Leetonia	607,288	551,022

Republic Iron & Steel Co.

Franklin	81,126	28,885
Kinney	471,522	347,456
Monica	77,946	46,922
Pettit	158,397	120,868
Schley	101,892	16,386
Union	247,504	244,436

Great Northern Properties.

Thorne	18,236	.....
Leonard	197,600	2,686,285
South Uno	21,558	945,840
Dale	116,336	423,711
Mace	120,888	160,815
Harold	86,341	489,042
Hill	998,649	592,590
Hill Annex	.....	3,272
Mississippi	.....	507,660
North Uno	.....	90,088

Butler Brothers.

North Harrison	169,947	.....
Harrison	239,075	154,732
Quinn	91,007	49,251

Inland Steel Co.

Laura	132,039	198,665
Grace	70,781	98,667

Miscellaneous Independent Mines.

Mahoning	2,311,923	1,212,287
Susquehanna	618,490	906,913
Shenango	939,674	546,519
Whiteside	31	242,996
Webb	.....	151
Agnew	.....	108,558
Hawkins	327,712	232,354
Perkins	.....	18,182
Miller	247,188	297,379
Wacootah	55,645	36,839
Cavour	.....	16,837
Woodbridge	175,428	71,440
Helmer	100,000	151,803
Euclid	2,448	.....
Bennett	50,475	25,868
Mace	120,888	160,815
Isabella	36,255	.....

Vermillion Range.

Pioneer	452,123	282,559
Savoy	76,708	74,541
Sibley	129,565	74,868
Soudan	77,034	74,972
Zenith	714,868	424,110

Cuyuna Range.

Kennedy	208,332	179,885
Pennington	117,068	.....
Ironton	.....	40,425
Cuyuna-Mille Lacs	50,000	51,292
Wilcox	50,000	.....
Thompson	202,638	178,202
Armour No. 1	79,774	.....
Armour No. 2	303,280	283,565

the ore, with a steam shovel and stockpile the mixed material separately as a lean ore reserve. The fee owners, in many cases, however, favor the separation of the ore from the rock. If this separation is made by hand in front of the steam shovel, it brings the cost up to an underground basis. Some efforts to solve this problem have been made by Butler Bros. who have developed a rough separating apparatus employing a grizzly. The relatively fine ore and small pieces of rock pass through the grizzly. The large pieces of rock and ore are retained and pass on to an apron or table where the chunks of rock can be picked out by hand. So far it has been impossible to eliminate the hand picking operation in any of the methods of separation considered.

In cleaning up the North Uno underground, formerly operated by the Oliver Iron Mining Co., the Great Northern interests have installed a gasoline driven hoist, which has worked very satisfactorily. It is believed there is a growing field for outfits of this character in the iron ore country, particularly where the work to be done will not justify a heavy investment in machinery. The Lake Shore Engine Works, Marquette, Mich., has developed an underground loading machine which appears to be practical under certain conditions. One of these machines has been used to good effect in the Judson mine near Crystal Falls for cutting drifts, etc. This machine costs about $5,000 and the underground loading problem has now resolved itself into a question of the interest, depreciation, repairs, etc., on a comparatively expensive machine as compared with the cost of labor.

SCHOOL HOUSE FITTED WITH CLUB ROOM AT ALPHA, MICH.

Estimates of the tonnage of ore in the ground, made by the Minnesota tax commission again show a decrease. While it would be unsafe to state that the day of large discoveries is past, the record of the past two years indicates that generally speaking, shipments are in excess of the new tonnage developed. On the other hand, the Oliver Iron Mining Co. is understood to have added about 30,000,000 tons to its Mesabi reserves during the past year, and this would indicate that the Steel Corporation, for the time being at least, is keeping its reserves ahead of its shipments.

The detailed figures of iron ore reserves in Minnesota as of May 1, 1914 and 1915, are given in Table III. As this table indicates, the reserves show a decrease of 3,254,423 tons. The aggregate reserves as of May 1, 1915, were placed at 1,465,070,417 tons, the figures for the corresponding date in 1914 being 1,468,324,840 tons. The deficiency for 1915 would be greater were it not for the fact that Cuyuna reserves, owing to new discoveries, increased from 70,857,865 tons in 1914, to 72,215,605 tons in 1915. Both Mesabi and Vermillion reserves show appreciable decreases.

In our review published Jan. 7, 1915, and in various issues of *The Iron Trade Review* throughout the year, reference was made to the unfortunate municipal tax situation on the Mesabi range. Attention was called to the excessive assessments in certain localities. "Taxes for state purposes on the iron ore industry in Minnesota", it was stated, "are not burdensome, but local county and village taxes, particularly the latter in some instances, are becoming extremely heavy. Blessed with taxable resources far beyond the dreams of avarice, there is no doubt but that many of the towns on the iron ranges have been led to indulge in unwarranted extravagance in the conduct of their municipal affairs. In villages ranging from 5,000 to 10,000 population, miles of streets have been paved in the most expensive and permanent manner, suitable for the traffic of a Broadway or a State street. Automobile fire apparatus has been purchased without stint and thousands of expensive ornamental lamp posts have been installed on the village streets". As a result, some of the towns spent considerably more than their extremely ample incomes and were brought face to face with heavy municipal debts.

The situation finally became so aggravated that the mining companies, who pay practically all the taxes, decided to take a hand and refused to pay their taxes for 1915 in the village of Hibbing. This precipitated a bitter controversy between the mining interests and the local authorities. The dispute finally was settled by a compromise on Nov. 23. The village agreed to scale its 1916 assessments down from $1,900,000 to $750,000 and in view of this concession, the mining companies agreed to pay their 1915 assessments in full. This is the gist of the settlement. The village also agreed to limit its general expenses to $24,500 per month. It is evident that the pressure which the mining companies were able to bring to bear resulted in a satisfactory adjustment of the difficulty. Comparatively little prospecting and drilling work was carried on during 1915. Nevertheless some interesting explorations were made in the somewhat virgin territory between the Mesabi and Cuyuna ranges. It is understood that Louis Rouchleau, of Minneapolis, located a property in this district on which it has been stated there are about 2,500,000 tons of merchantable ore. It is also said that this ore body contains appreciable quantities of manganese. The drilling was done very quietly and the work indicates a possible connection between the Mesabi and Cuyuna ranges.

On the western Mesabi, the Jones & Laughlin steel interests are understood to have retained three of the large number of leases which they held in that territory until about a year ago. Quantities of washable ore are known to exist in this region. The Hartley interests of Duluth are understood to have developed a deposit of from 5,000,000 to 6,000,000 tons of merchantable ore on one property west of Pokagama lake in the vicinity of Grand Rapids. In line with its policy of maintaining

its ore handling facilities in advance of its immediate requirements, the Steel Corporation has let contracts for a large new ore dock to be built at Two Harbors. This structure, which will contain 228 300-ton pockets, will be erected by the Duluth & Iron Range railroad. The new dock will be 1,431½ feet in length over all, 63 feet wide and 80 feet high to base of rail. The spout hinges will be 40 feet from the water. There will be four tracks, two over each set of bins spaced 13 feet center to center in accordance with recent legislation. The foundation will be concrete and the superstructure steel with concrete lined bins. The bin floors will be finished in smooth concrete instead of being lined with maple as has been the practice heretofore. It is expected that this will save about 1,300 board feet of flooring in each pocket thereby reducing the cost approximately $30 per pocket. Furthermore, periodic flooring renewals will be obviated. The bins will be provided with a floor angle of 48 degrees. The new dock will be arranged so that the slip between it and the adjacent structure will be widened from 150 to 200 feet; this will aid materially in handling vessels in and out of the harbor. The new dock, of course, will be provided with electrically operated spout hoists and other modern auxiliary equipment.

As announced in *The Iron Trade Review*, Dec. 9, 1915, the iron ore buying movement for the ensuing season commenced on Dec. 7, when prices were fixed at a net advance of 75 cents over those ruling during the season of 1915. According to the new scale, old range bessemer is quoted at $4.50; Mesabi bessemer at $4.20; old range non-bessemer, $3.75, and Mesabi non-bessemer $3.55 per ton, delivered at lower lake ports.

Considerable interest remains attached to the operations of the Great Northern ore trustees, owing to the exceptionally large volume of tonnage which they control, although their sales policy is now definitely outlined. The Great Northern people proceeded vigorously with the development of their properties during 1915, and at the same time restricted their shipments to approximately, 1,750,000 tons, including the ore forwarded from recently leased properties near Hibbing and Nashwauk. The Great Northern interests undoubtedly will ship and sell ore liberally during 1916, but only insofar as the tonnage can be disposed of to advantage.

The various properties taken over from the Steel Corporation were operated throughout the season by the Arthur Iron Mining Co., a subsidiary of the Great Northern Trustees. The Harold mine, for instance, turned out about 1,000 tons a day and other properties were operated at varying rates. The Great Northern people are understood to have had approximately 1,500,000 tons of ore in stock on Dec. 1, 1915. Stripping operations were prosecuted vigorously at the Dunwoody and Hill Annex properties. One new mine was opened, the Alexandria, near Chisholm. This is an underground property containing approximately 1,500,000 tons of ore and the development work was started on July 1. As stated previously, this mine will be operated entirely by electricity. The mine is so dry that it is necessary to carry water down to the men at work underground. The annual report of the trustees for the year ending Dec. 1, 1914, showed that the certificate holders had assets in cash of $3,820,455.69 at the end of last year. The report also contained the following interesting statement: "Following the policy heretofore declared, the trustees are holding their resources for the purpose of financing the proprietary companies as the needs of those companies may be developed by the events consequent upon the termination, Dec. 31, 1914, of the lease to the Great Western Mining Co." The details of operations under the now famous lease between the Great

Table V.

SHIPMENTS AND ROYALTIES UNDER THE HILL LEASE

Yr.	Tons Shipped	Average % Iron	Average Royalty (*)	Royl. Rec'd Incl. Freight	Deficiency Minimum Royalty		
					Tons	Rate	Amount
1907	137,270	58.7641	$ .838726	$ 225,020.07			
1908	508	65.1498	1.180295	1,005.95	1,499,492	$.884	$1,325,550.97
1909	41,624	56.4001	.792687	32,994.80	2,208,376	.918	2,027,289.07
1910	2,046,970	56.9633	.853830	2,854,379.52	847,024	.952	806,366.48
1910	106,007	49.00	.30	110,378.95			
1911	5,344,078	58.2148	.945308	8,591,830.70	(e)		(a) *1,325,550.97*
1911	155,681	49.00	.30	155,450.51	(e)		(b) *140,502.05*
1912	7,435,051	58.3212	1.186650	12,613,637.71	(f)		(c) *1,886,787.02*
1912	55,458	49.00	.50	55,830.85	(f)		(d) *806,366.48*
1913	5,221,987	59.6211	1.283936	9,359,435.02	13,110	1.2540	16,440.38
1913	14,903	49.00	.50	12,632.89			
1914	6,008,071	58.8038	1.284627	11,155,370.76	(h)		(g) *16,440.38*
1914	6,197	49.00	.50	6,257.57			
	26,235,562	58.5622	1.150878	44,833,674.53			
	338,246	49.00	.345268	340,550.77			

Total 26,573,808

Grand total receipts from G. W. M. Co., including interest earnings....$45,174,225.30

(*) The schedule price of ore shipped by the Great Western Mining Company, when hauled by the Great Northern Railway Company, includes delivery at Lake Superior, the rail freight being paid by the lessor companies. This freight was 80c per ton until the close of the shipping season of 1911, when it was reduced to 60c per ton. For convenience, the royalty rates above shown are the net rates, after deduction of freight.

(a) 1908 deficiency minimum, absorbed by shipments.
(b) Portion of 1909 deficiency minimum absorbed by shipments.
(c) Balance of 1909 deficiency minimum absorbed by shipments.
(d) Deficiency minimum of 1910 absorbed by shipments.
(e) Includes, in addition to payment at the regular schedule rates for the required minimum shipments for the year 1911, the entire amount of the 1908 deficiency minimum and a portion of the 1909 deficiency minimum payments, absorbed by 1911 shipments, as shown by (a) and (b), together with $154,187.49 interest earned thereon.

(f) Includes royalty for the 1912 quota of shipments and 18,242-1310 tons in addition, at 1912 rates, together with the balance of 1909 deficiency minimum credit, and all of the 1910 deficiency minimum credit, of the Great Western Mining Company, absorbed by shipments during 1912, as shown by (c) and (d), also $267,666.42 interest earned thereon.

(g) Deficiency minimum of 1913 absorbed by shipments.

(h) Includes royalty for the 1914 quota of shipments and 1,573-1071 tons in addition at 1914 rates, 12,697-1780 tons to cover the 1913 deficiency minimum credit of $16,440.38 of the Great Western Mining Company, absorbed by shipments during 1914, as shown by (g), together with $346.04 interest earned thereon.

Northern interests and the Steel Corporation are set forth in Table V. The aggregate minimum shipments required by the terms of this lease amounted to 27,000,000 tons and the report shows that actual shipments were 26,573,808 tons, including 338,246 tons of ore running under 50 per cent iron. These figures would indicate that the Corporation failed by 426,192 tons to ship the required minimum for the years 1907 to 1914, inclusive. However, the minimum for the year 1907 was 750,000 tons, of which only 137,270 tons were shipped, leaving a deficiency for that period of 612,730 tons. This deficiency was finally waived in 1912 in connection with negotiations that resulted in the transfer of properties that had not been opened for mining back to the lessor companies, in order that they might proceed with developments prior to the time when the lease would terminate. This waived deficiency taken from the 27,000,000 tons leaves 26,387,270 as a minimum to be shipped, which is 186,538 tons less than the shipments made. Hence to that extent, the Steel Corporation did more than its contract required.

Progress on the Cuyuna

This review would not be complete without some reference to the splendid progress that has been made on the Cuyuna range during the past year. This range has shown a steady growth in output since its inception and the developments now under way indicate that a considerable increase in production may be expected next year. Commencing with 147,431 tons in 1911, the output has increased steadily, the shipments for 1915 being 1,133,643 tons. A complete review of Cuyuna range developments was contained in a paper by Carl Zapffe, published in *The Iron Trade Review*, Dec. 9, 1915. Some data regarding the operations at the Croft and Hillcrest properties may be added to Mr. Zapffe's summary.

According to tax returns, the Croft mine operated by the Merrimac Mining Co., is understood to contain 2,550,000 tons of ore. A considerable portion of it is of bessemer grade. A 6 x 18-foot three-compartment shaft has been sunk 222 feet to the first level which is now well developed. In order to handle the water, a 20 x 80-foot timbered pump station has been provided on the main level and two 2,200-gallon Prescott pumps installed.

The hydraulic stripping operations at the Hillcrest mine, operated by the Hill Mines Co., are exceedingly interesting. Unusually favorable costs have been shown, it being stated that the material is handled for about 10 cents a cubic yard. This is approximately half the cost of steam shovel stripping. The operations have been pursued continuously commencing with an initial excavation of 85,000 yards the first month. The plans now being worked out provide for the ultimate removal of 1,000,000 cubic yards and about half of this quantity already has been disposed of. The material is sluiced down into a sump with a hydraulic giant served by a 4,000-gallon Epping-Carpenter volute pump. The pressure head at the pump is 170 feet.

The sludge, containing about 16 per cent solids, is removed from the sump by a 4,000-gallon single stage motor-driven sand pump, which is mounted on a flat car, as indicated in the accompanying illustrations. The sand pump works against a static head of 52 feet and a friction head of approximately 100 feet. No difficulty is experienced in handling boulders up to the size of a man's head. The entire hydraulic stripping outfit, it is said, cost only $12,000. It is interesting to compare this figure with the cost of a complete steam shovel outfit, which would be in the neighborhood of $50,000.

The Quinn mine, which is being opened by the Mahnomen Mining Co., also possesses features of interest. This property, which is an open pit, is being stripped by A. Guthrie & Co., and two steam shovels are at work at the present time. It is understood that the stripping contractors have made an unusually favorable record, turning out nearly 200,000 cubic yards with one shovel in a month. This machine was operated in three shifts and was served by five locomotives and trains. There are about 1,000,000 yards of stripping on the Mahnomen property, which the Minnesota tax commission estimates to contain 3,375,000 tons of merchantable ore.

Air-Lift Pumping

The theory and practice of pumping water from deep wells by means of compressed air is interestingly explained in an 80-page treatise recently published by the Ingersoll-Rand Co., New York. A description of the company's air compressors used in this work also is given. Air-lift pumping, it is said, in the past has been surrounded with more or less mystery, but the operation of this method of pumping is really quite simple. It is based upon the fact that a column of water in a pipe, artificially made lighter than another column of water surrounding the pipe, is forced by the latter upwards and out. Compressed air is the means by which the water in the pipe is broken up and its specific gravity reduced. Fine streams of air are thoroughly mixed with the water and serve to move it upwards, owing to its buoyancy and expansion. It is said that 900 gallons of water per minute have been forced from a single 6-inch well by the air-lift process. A feature of this method is that a number of wells may be operated by but one air compressor, the air being piped wherever needed. The Ingersoll-Rand Co.'s treatise contains interesting data derived from tests of their installations in various parts of the United States and Mexico.

The company's product is made in several models, including the side inlet pump, in which air and water pipes are placed alongside each other in the well and connected at the bottom with an end piece, and an adaptation of this same method using a special device to connect the two pipes. In some instances the well does not permit the use of the side inlet system, a central tube being then suspended inside the well, the air passing down between it and the well casing. The water is discharged through the central tube. The third method utilizes an air pipe suspended in the center of the bore, eduction taking place between the air pipe and the well casing. Another type of pumping device made by the company consists of an outer shell or casing with an inner tube of brass, which has a series of rings of small holes drilled about its periphery. These rings of holes create sufficient back pressure in the pump to prevent slippage losses, and are said to give ideal control over the admission of air to the eduction column. The operation of a "booster" device for use with these pumps is also described. A chapter profusely illustrated with diagrams is devoted to arrangement and methods of piping calculated to secure maximum results. The Ingersoll-Rand Co.'s "return-air" pumping system, which is a form of pneumatic displacement pump, is set forth at some length. Considerable space is given to a discussion of the value of compressed air in commercial work, such as the agitation of fluids and heavy mixtures, including cement slurry, pulp and asphaltum, and the cyanide process of treating ores. Ten models of air compressors, steam, oil and electric driven, are described and illustrated in detail.

Tables including water friction, wrought iron pipe dimensions, pressure loss in compressed air transmission, mean effective pressure and horsepower, etc., are also given. The book contains many illustrations of Ingersoll-Rand pumps at work in various parts of the world.

Electric Drive at Massillon Mill

THE UNIQUE position of the Central Steel Co. as the first steel plant to be equipped throughout with electric drive, has attracted considerable interest to this mill. Mr. Stoltz presents interesting data showing the actual performance of the electrical apparatus under operating conditions. Refinements of control secured in this installation are explained, together with the method of handling widely intermittent loads.

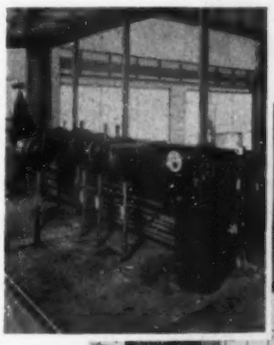
By G. E. Stoltz

SEVEN months' continuous operation has clearly demonstrated the practical utility of the electric drive used throughout the new plant of the Central Steel Co., Massillon, O. The installation of the motor equipment at this works was followed with close attention by electrical engineers as it was the first attempt to use electrical energy in a steel mill to the almost complete exclusion of other methods of furnishing power. The facts presented in this paper deal largely with the results shown by actual mill operation.

The Central Steel Co.'s plant was described in full in *The Iron Trade Review*, Jan. 7, 1915. The works comprise three 50-ton open hearth furnaces, a 34-inch reversing blooming mill and a 24-inch bar mill. Electrical apparatus is used for driving not only the main units and ordinary auxiliaries, but also for operating the manipulators, soaking pit covers and open hearth furnace doors. Alternating current is purchased at 2,200 volts, 3-phase, 60-cycle from the Massillon Gas & Electric Co. and the Massillon Rolling Mill Co., the latter being an affiliated concern. The Massillon Rolling Mill Co. has a 1,250-kilowatt low pressure turbine operating from the exhaust steam of a sheet mill engine. It is governed to operate at its full capacity. The rest of the power is obtained from the Massillon Gas & Electric Co., which is equipped to supply a maximum of 3,000 kilowatts. The substation is located in a building parallel to the blooming and bar mills, the spindles from each of the driving motors extending through the walls to the mills. In the same room are located the incoming lines, transformers, rotary converters, etc., practically all of the electrical apparatus of the plant being under the supervision of one man. In addition, all electrical repair work is carried on in this building, giving a very compact and convenient arrangement of all the electrical apparatus. Transmission losses are thus eliminated and normal voltage insured at the motor terminals.

When shutting down for a short period, the circuit breakers on the incoming lines are opened and all standby losses thus eliminated. When the plant resumes, these circuit breakers are closed and all of the apparatus started up within a few minutes by one man. This differs widely from steam-driven plants, where is is necessary to contend with the losses and maintenance of steam lines, and where idle time must be spent in repairing the engines, boilers, etc. Interruptions from the central station are few and the maintenance and attendance of the large apparatus is stated to be approximately 20 per cent of the equivalent steam units.

The 34-inch reversing blooming mill is direct connected to the Westinghouse reversing mill motor shown in Fig. 5. The heavy ribbed construction of the frame indicates the special design and rugged construction followed in every detail of the entire machine. The load on this machine is highly intermittent, varying from zero to 8,000 horsepower as a motor, and to a similar amount when it regenerates during the braking period to bring it to a standstill. The stresses set up during such a cycle require the winding to be braced and the mechanical construction throughout to be able to withstand stresses not common to any other electrical application. The apparatus represents a decided departure from previous practice. As it is practically prohibitive to carry this intermittent load on a central station or power plant, a motor-generator flywheel set is employed to equalize the central station load. A view of this set from the direct current end is shown in Fig. 7. It consists of a 1,500 horsepower alternating current motor driving a flywheel and generator. The flywheel for purposes of safety is completely enclosed in a metallic case. The electrical design of the generator is similar to that of the motor, so that it is capable of withstanding very high momentary loads. The



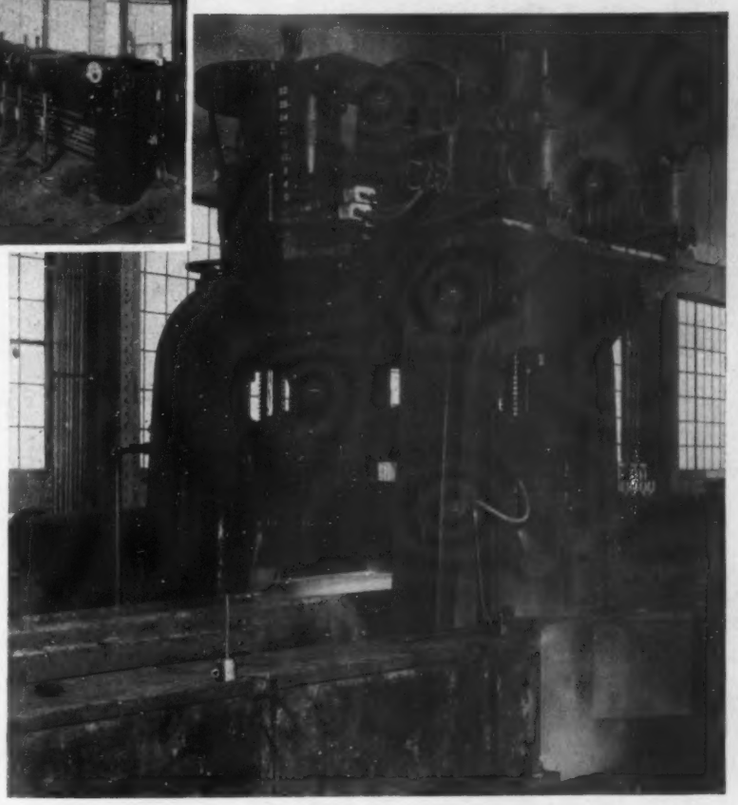


FIG. 1—BLOOMING MILL AND OPERATING PULPIT, SHOWING SIMPLICITY OF CONTROL MECHANISM

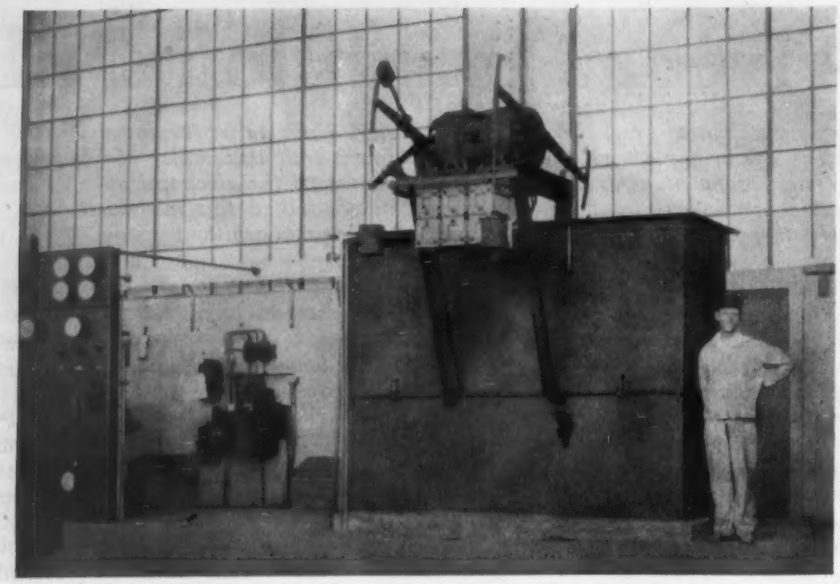


FIG. 2—LIQUID SLIP REGULATOR WHICH EQUALIZES INPUT TO MOTOR-GENERATOR FLYWHEEL SET

direct current generator is connected directly to the terminals of the reversing motor with no switching apparatus interposed, except a large carbon circuit breaker for overload protection. The operation of the reversing motor is controlled by the field of the generator up to the full field speed of the reversing motor, after which the field of the latter is weakened to obtain high speeds for light finishing passes. Fig. 6 is a view of the switching apparatus employed for this installation. The control apparatus is designed to obtain rapid response as the interval between passes on this mill is two seconds, when the ingot is not turned by the manipulator fingers. The speed of the reversing motor is practically independent of the load on the mill, and watching the motor alone, it is impossible to determine when the metal is passing through the rolls. If desired, the motor can be turned very slowly until the metal enters the rolls after which it can be brought up to normal speed. No racing is observed as may occur with engine drive. The motor accelerates smoothly, avoiding breakage of the spindles or couplings, as well as rapid wear on the rolls. The life of the rolls of this mill is several times that generally obtained. The whole operation is carried on quietly and a person standing in the motor room would not suspect that a blooming mill is in operation just outside of the substation.

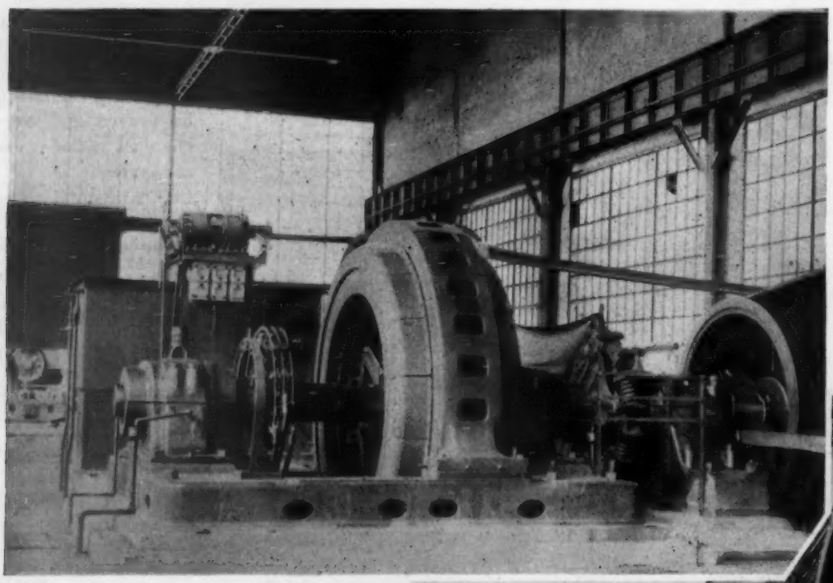


FIG. 3—MOTOR CONNECTED BY FLEXIBLE COUPLING TO ROPE SHEAVE OF BAR MILL

The alternating current motor operating the flywheel set, is controlled by the liquid slip regulator shown in Fig. 2. This special apparatus also was designed particularly for rolling mill work. Its principle is the same as that of a water rheostat, with three fixed metallic plates at the bottom to which the secondary winding of the motor is connected. The double torque motor mounted on the top of the regulator, operates two balance arms. At one end of these arms are suspended three moving electrodes while the other supports counterweights. The winding of the torque motor is connected in series with the primary circuit of the alternating current motor on the flywheel set, so that the effort of the torque motor is always in synchronism with that of the large motor. As the large motor takes on a load, the small torque motor tends to separate the plates and introduce resistance in the secondary circuit causing the big motor to slow down and transfer the peaks to the flywheel. Although the reversing direct current mill motor develops peaks of 8,000 horsepower,

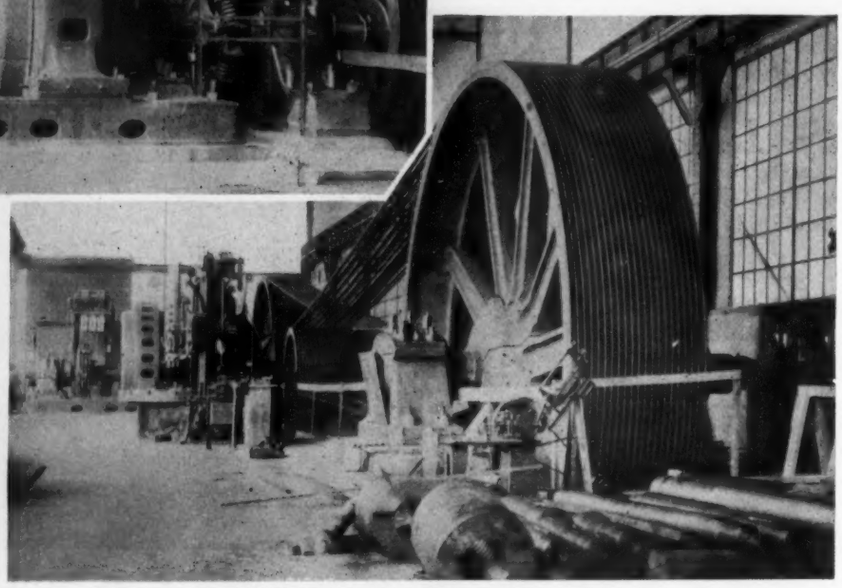


FIG. 4—ROPE DRIVE FOR TWO-STAND, THREE-HIGH BAR MILL

the power required by the alternating current motor seldom exceeds 1,100 kilowatts, thus keeping the power house capacity within very reasonable limits. This liquid regulator also limits the input during the starting period and although this application requires a large amount of flywheel effect, the complete set can be started up in five minutes, taking an input not in excess of 1,200 kilowatts.

The Question of Cost

At first sight, this amount of apparatus seems almost prohibitive as engine drive appears to be very much more simple and economical. However, with the flywheel motor-generator set omitted, the same conditions would prevail as are obtained with engine drive. In other words, the generating equipment required would be of the same capacity as the boiler equipment for engine drive. At this plant a large variety of steel, both in size and chemical composition is rolled, but ordinarily the total power required from the incoming line, including all losses, averages from 20 to 30 kilowatt-hours per ton of metal rolled.

Bar Mill Equipment

The bar mill consists of two 24-inch three-high stands each connected to a large rope wheel, as shown in Fig. 4. Half way between the two stands is a Westinghouse 1,500-horsepower motor, operating at 270 revolutions per minute. It is coupled to a rope sheave. From this sheave ropes extend to each rope wheel. A spring type coupling is placed between the motor and rope sheave to relieve the motor from shocks and to protect the bearings should any misalignment occur. The motor is shown in Fig. 3. It consists of a standard rolling mill motor ruggedly constructed throughout and provided with low pedestals, piped for both water cooling and gravity oil feed, which are to be used only in an emergency arising from defective bearings. Under normal conditions oil ring lubrication is adequate.

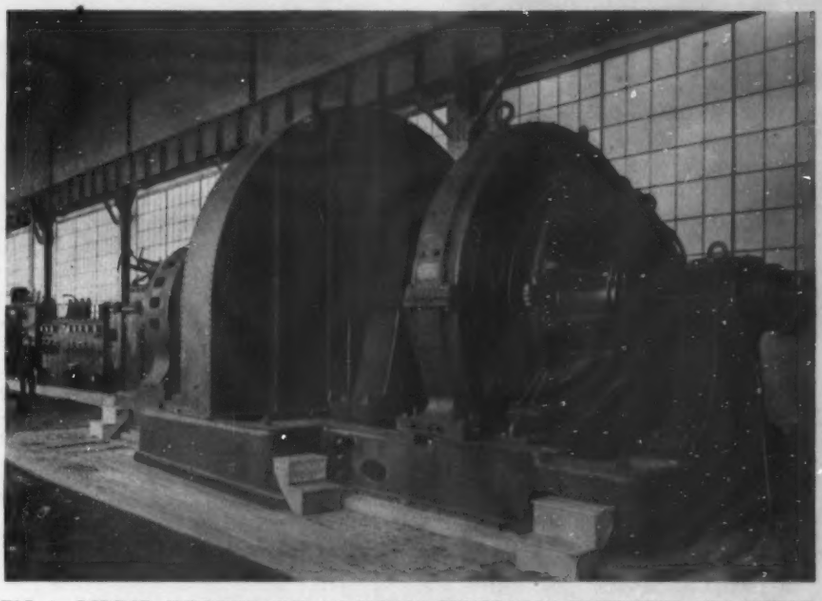


FIG. 7—DIRECT CURRENT END OF MOTOR-GENERATOR FLYWHEEL SET WHICH EQUALIZES LOAD ON BLOOMING MILL

Ingots averaging 18 x 20 inches are first rolled in the blooming mill to 8 x 3-inch billets and then are sheared and sent directly to the bar mill without reheating. In the bar mill, they are rolled to sheet bars in six passes and one bullhead pass.

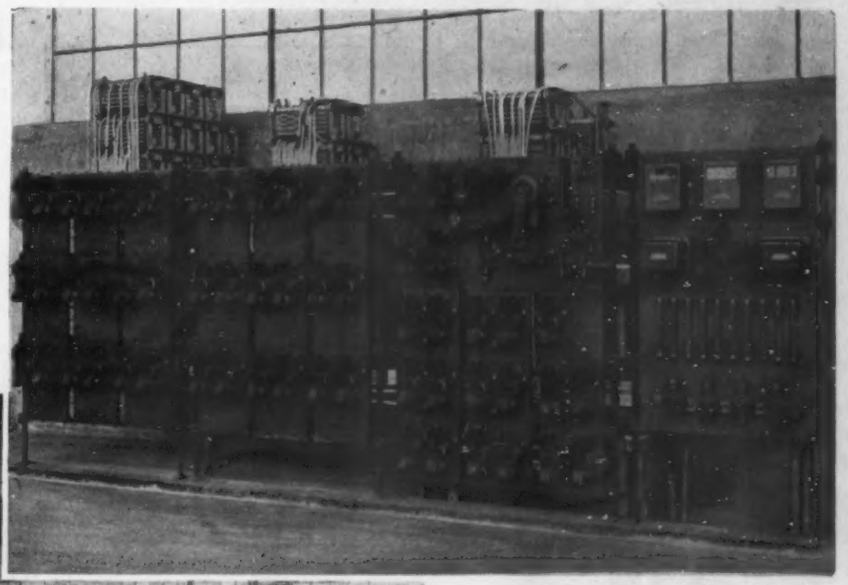


FIG. 6—CONTROL PANELS FOR BLOOMING MILL

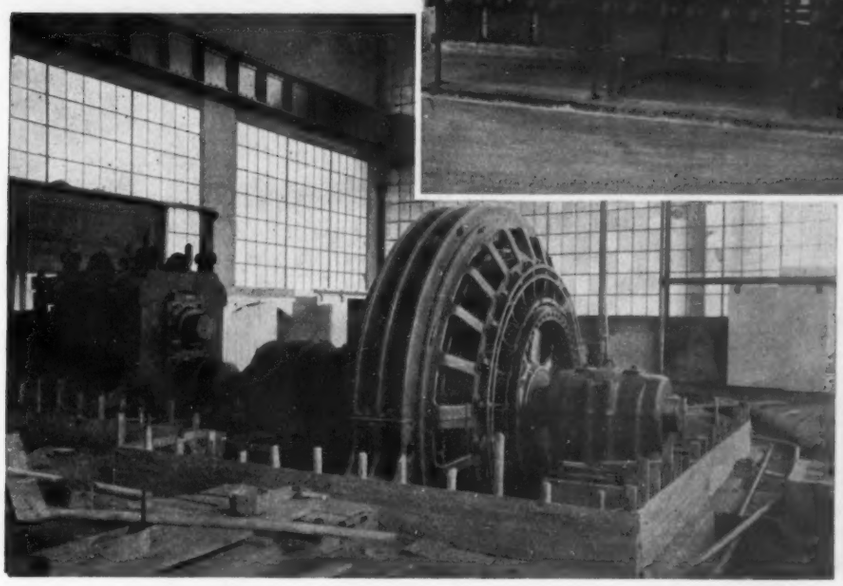


FIG. 5—REVERSING MILL MOTOR COUPLED DIRECT TO BLOOMING MILL

The Trussed Concrete Steel Co., Youngstown, O., describes its mesh for reinforcing concrete floors, roofs, roads, pavements, sewers, conduits, tanks, walls, culverts, and bridges in a recent 32-page bulletin. The method of manufacture is explained in detail and a number of photographs are presented showing this company's product in service.

Completes First of New Furnaces

THE EXTENSIVE plans inaugurated by the Pennsylvania Steel Co. several years ago, for the modernization of its Steelton works are being pushed. Additions to the steelmaking and finishing capacity have been prosecuted steadily and work is now advanced on rounding out the blast furnace equipment to meet the expanded demand for steel. The first modern 500-ton stack is operating and a second is being built.

By Samuel Higginson

AS AN important part of the extensive improvements to its works at Steelton, Pa., the Pennsylvania Steel Co. has begun the modernization and rebuilding of its present group of blast furnaces. The program of improvements at this plant, which was inaugurated three years ago, is now well advanced. A new steel works primarily aimed for duplexing on a large scale, was completed and put in operation about a year ago. This consists of two Campbell tilting open hearth furnaces of 200 tons capacity each; six 90-ton stationary basic open hearth furnaces; two 25-ton bessemer converters and 800 and 400-ton metal mixers. The steel works is located south of and parallel to the blast furnaces, and near the Susquehanna river, which marks the south boundary of the company's property. The blast furnaces and steel works are so located as to permit the easy transfer of hot pig metal.

More recently, a 28-inch standard structural mill was installed in the finishing department; it was started about six months ago. Other enlargements and betterments of finishing capacity have been made and still others now are being carried out or are planned. The modern blast furnace group is being provided to balance off these extensions to steelmaking and finishing capacity. The first unit of the proposed new blast furnace group is known as the No. 5 furnace. It was blown in Sept. 20, 1915. In all details it is a thoroughly modern, mechanically-filled stack, the first of its type to be built at Steelton. Its daily capacity is 500 tons. The same general lines will be followed in the eventual replacement of the four other furnaces at Steelton, which are many years old and are of the hand-filled class. Preliminary work on the reconstruction of one of these furnaces, No. 3, now is under way. In connection with the building of the No. 5 furnace, an extensive new ore yard, stock storage bins and other facilities for the rapid handling of raw materials, have been laid out and now are in an advanced stage of completion. These are to fit in with the general plans covering the ultimate furnace construction.

The new furnace was designed by the engineers of the Pennsylvania Steel Co. and was built under their direction, the fabrication work being done in the shops of the company. The furnace has been designed to meet special requirements per-

Historic Furnaces

The several blast furnaces that the Pennsylvania Steel Co., proposes to replace by modern plants have had long and historic careers. Nos. 1 and 2, especially, figured prominently in the early days of bessemer steelmaking in this country, which the Pennsylvania Steel Co. adopted at Steelton as early as 1867. Metal for the first steel rails to be rolled in this country on an order from the railroads, was supplied by the Steelton works. These rails were manufactured by the Cambria Iron & Steel Co. at Johnstown, in 1867. This, however, was before the present furnaces were built. No. 1, 60 x 16 feet, was built in 1872 and 1873 and remodeled in 1883; No. 2, 80 x 18 feet, was built in 1874-1876 and rebuilt in 1877; No. 3, 85 x 18 feet, was built in 1883-1884; and No. 4, 75 x 17 feet, in the same years.

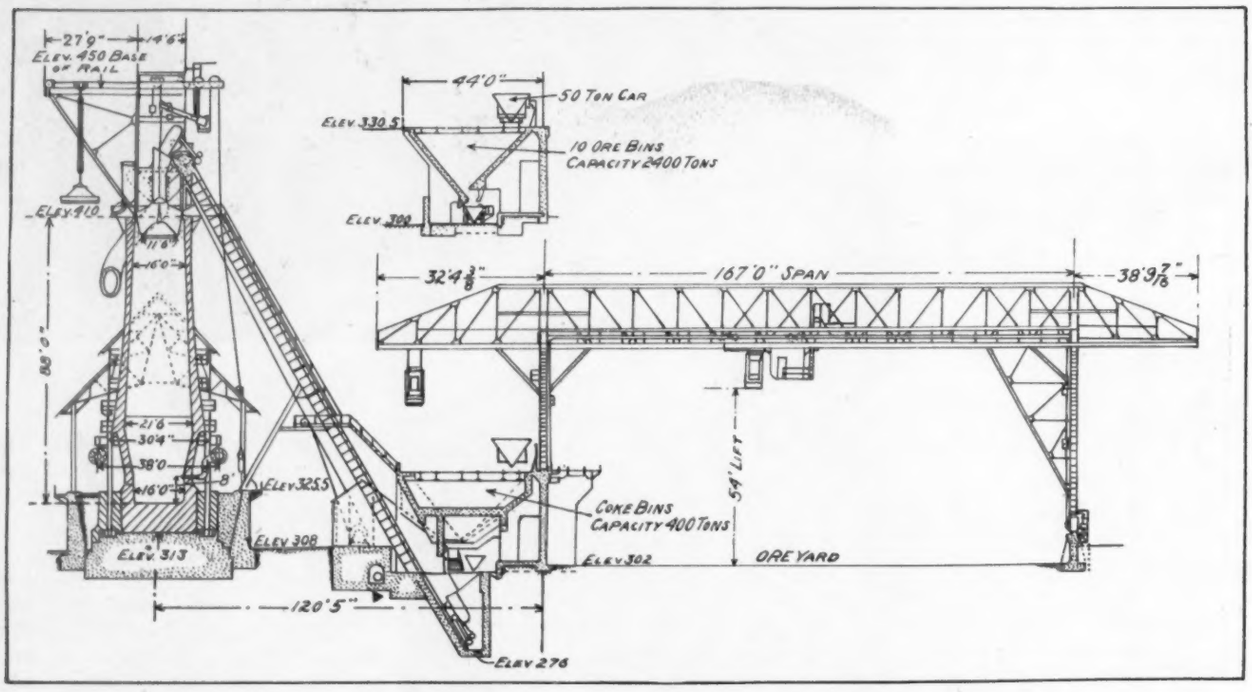


FIG. 1—SECTION THROUGH NEW BLAST FURNACE PLANT OF PENNSYLVANIA STEEL CO.

taining to ore consumption since the company draws its ore largely from its mines in Cuba. The usual mixture is made up of fine and coarse Cuban ore. The fine ore is from the Mayari, or north coast Cuban mines of the company and is used in nodulized form. The coarse is from the Daiquiri, or south coast deposits. War conditions which have reduced the movement of ore from Cuba because of vessel shortages, and other circumstances, have altered temporarily, the plans to use Cuban ore. Lake Superior mineral has been substituted and it has been found that the furnace works as well on this ore with its all-fine physical structure as it did on the Cuban product.

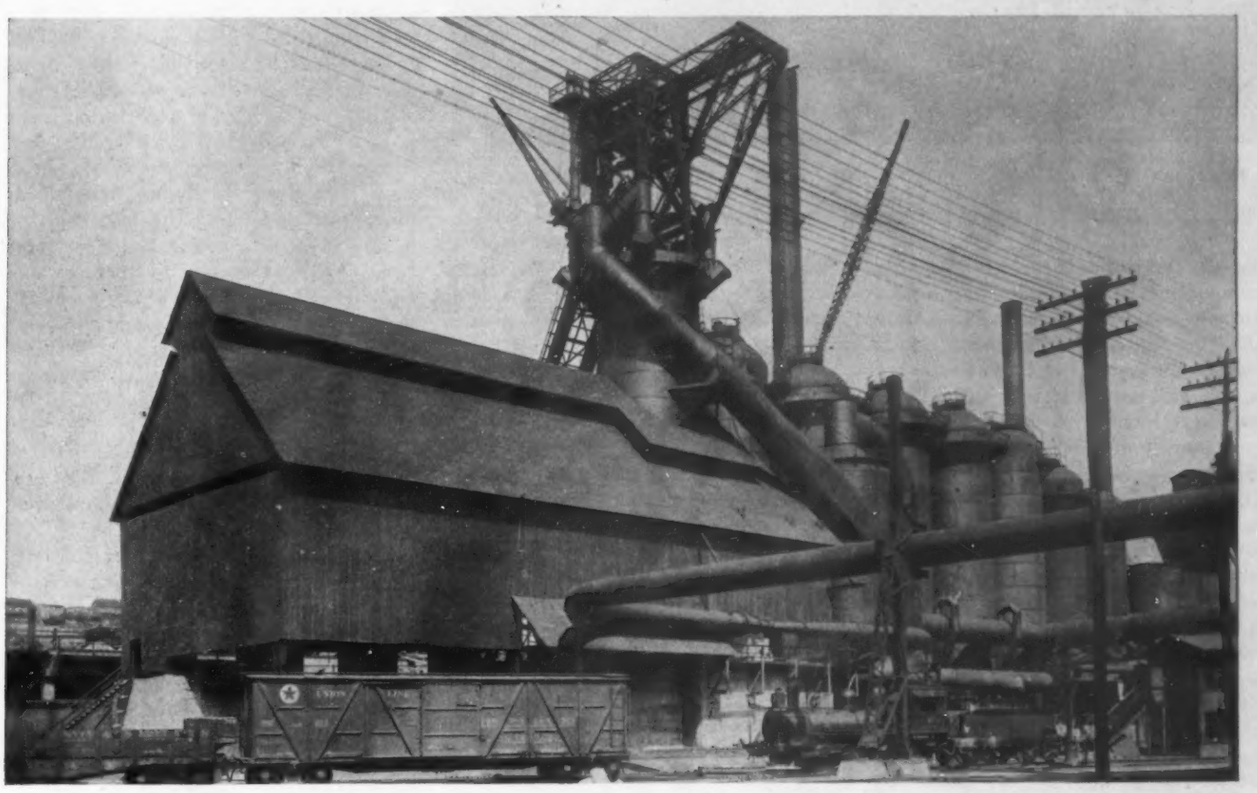


FIG. 2—GENERAL VIEW OF NEW FURNACE SHOWING TOP CONSTRUCTION, ARRANGEMENT OF STOVES, GAS MAINS AND BLAST PIPE

Furnace No. 5 is located in a central position in the Steelton group and at the extreme north of the steel company's property. To the east and immediately adjoining the new stack, are furnaces Nos. 3 and 4; to the west and some distance away, are furnaces Nos. 1 and 2. The location of No. 5 was determined by the important scheme of further blast furnace extensions which the company has in view. It is planned to build other modern furnaces; similar in type to No. 5, both east and west of it. This means the practical reconstruction of the No. 3 and No. 4 plants, which originally were built in 1883-84 and are of the hand-filled type. This work will involve the construction of stacks equipped with electric skip hoists, cast houses and other features of modern plants, though some of the present stoves will be used. The daily capacity of the furnaces will be increased to about 500 tons each. Work on the rebuilding of the No. 3 plant already is under way. Another completely new furnace plant is proposed on a location to the west of No. 5 and in direct line with it. The cast house of this proposed furnace will be to the east of the stack and in line with the cast house of No. 5, the hot metal tracks running between the two structures. This will facilitate the transfer of hot metal by ladle cars to the steel works since most of the product of the furnaces is used in duplex steel working. The laying out of the new ore yard and the building of ore trestles and storage bins, which now are well advanced, are being done with the further furnace extensions in view. The scale of construction is comprehensive in order to serve all future requirements.

Details of Furnace

The new No. 5 furnace is strictly modern in every detail. It is 87 feet in height, 21 feet 6 inches at the bosh, 16 feet at the hearth and 16 feet at the stock line. The design of the stack illustrates the present trend, in furnace construction, to reduce the taper between the bosh and stock line and to produce a more perpendicular effect. The sub-base is of concrete, supported by concrete piles, upon which fire brick are laid. The shell and mantle rest on six built-up structural steel columns, 30 feet high, which set on cast iron bases. The bosh is entirely encased in a steel jacket built of heavy steel plates, ¾-inch in thickness. This jacket is pierced by bronze cooling plates of standard design in which the water circulates upward and is discharged above the bosh line. There are five rows of these cooling plates in the bosh and seven rows of mantle plates. The steel-jacketed bosh has been adopted because of the greater protection it offers against break-outs, while its cost is only moderately greater than where encircling steel bands are used. The top of the stack is of the usual double-bell type. Over the small bell is a cast steel tube 4 feet in diameter and 8 feet 6 inches high with a hopper top into which the stock is discharged. This allows a better distribution of the charge. There are two bleeders of 2 feet inside diameter. The lining of the stack is practically uniform at 27 inches thick.

The downcomers are four in number, with branches leading into two main downcomers. These in turn converge into one large branch which connects with the dust-catcher. The latter is of the centrifugal type, with a 25-foot shell

FIG. 3—CONCRETE ORE AND STONE BINS WITH ORE BRIDGE IN DISTANCE. FURNACES NOS. 3 AND 4, WHICH ARE TO BE REPLACED, ARE SHOWN IN THE BACKGROUND

and 22 feet inside diameter. The gas main of the No. 5 furnace is connected with the mains of furnaces Nos. 3 and 4. Through these mains, the gas is drawn to washers and prepared for use in the gas engine blowing plant. The washing is done in two static scrubbing spray towers of the company's own type and by washers of the standard Theisen type. At the present time, the stoves are being heated by unwashed furnace gas. The hot blast is supplied from four two-pass stoves, 24 x 100 feet, which are of the company's own design. These have side combustion chambers and are fitted with two Kennedy chimney valves. The bustle pipe is 5 feet outside and 2 feet 8 inches inside diameter. The blast is applied through 12 tuyeres, 6 inches in diameter, which are located 7 feet above the iron notch. The blast furnace pressure averages about 14 pounds per square inch and the temperature of the blast about 1,200 degrees Fahr.

Cast House Details

The cast house is 130 x 56 feet and is of heavy steel-framed construction. Provision is made for a traveling crane over the casting floor for handling the runners. The sidings are of corrugated steel sheets and the roof of steel plates, ⅛-inch thick. The roof is made steep in order to cause flue dust to run off by gravity. The floor is laid with paving brick. There is one main runner from which four iron runners extend to the south side, where the metal is delivered into 45-ton ladle cars for the steel works. Ordinarily, no pigs are cast but the works is equipped with two two-strand Heyl & Patterson casting machines. Four spouts may be used if required. The cinder flows down a runner along the side of the cast house, and is directed to four spouts which deliver to Treadwell cinder cars, of 260 cubic feet capacity, on tracks north of the cast house. The cinder cars are operated on a track paralleling the cast house. Both cinder and iron tracks are double-ended. Eventually, all cinder will be handled to the dump on tracks passing down the north side of the line of furnaces, while all hot metal will be handled to the mills along the south side.

The filling of the furnace is accomplished by a double skip electric hoist, which operates in balance. It was designed by the company's engineers. The hoist is actuated by a Lidgerwood engine, driven by a 150-horsepower Westinghouse motor. The hoist is fitted with a Cutler-Hammer automatic control. The skips have a capacity of 125 cubic feet each.

Storing Raw Materials

A close study has been made by the Pennsylvania Steel Co. of the transfer and storage of raw materials and a very complete and modern layout has been provided. The new ore yard extends along the line of furnaces Nos. 3, 4 and 5, on the north side. It is about 1,200 feet long and 167 feet wide, and is equipped with an Alliance bridge of 230-foot span, fitted with a Hoover & Mason, 7½-ton grab bucket. The yard has a storage capacity of about 450,000 tons of ore. This is sufficient for the purpose of the company, especially when the furnaces are working on Cuban ore, since shipments can be continued throughout the year. The bridge is so located that it can distribute the ore from the storage piles to the bins or stock houses for the use of furnaces Nos. 3, 4 and 5 or into a McKee 50-ton electric larry for transfer to furnaces Nos. 1 and 2. This larry operates on a standard gage track which is the outer one of four laid on a trestle extending the length of the ore yard. This track is under the main span of the ore bridge. The three other tracks run over the coke, ore and limestone bins.

These bins are of reinforced concrete construction and were built by the Raymond Concrete Pile Co. There are ten ore and limestone bins for furnace No. 5. These bins extend 46 feet from the center of the south ore bridge track to the opposite edge and have a total stor-

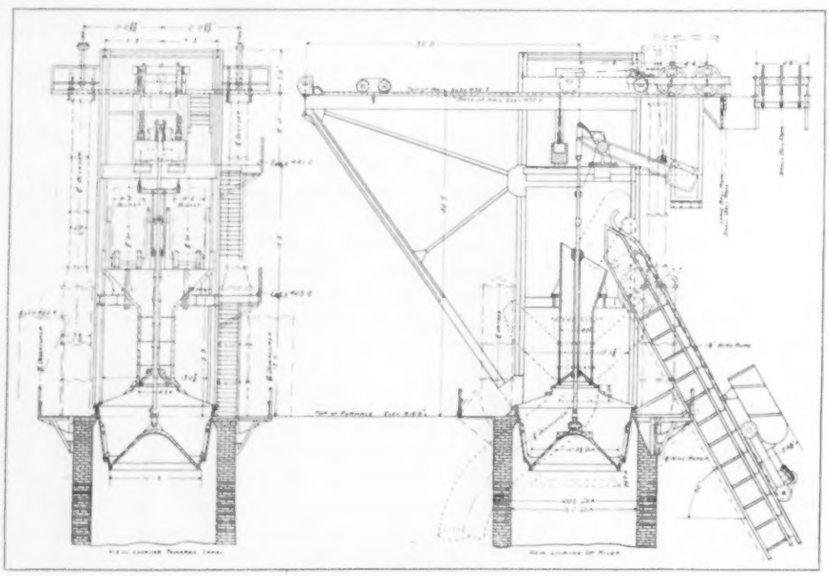


FIG. 4—VERTICAL SECTIONS THROUGH FURNACE TOP

age capacity of 2,400 tons. For the No. 3 furnace, 12 ore bins are under construction and seven are now completed. Eventually about the same number will be added for the No. 4 furnace. In addition, a large concrete coke bin with a capacity of 400 tons, has been provided for the No. 5 furnace and a similar bin is to be built for each of the Nos. 3 and 4 furnaces. These ore, limestone and coke bins are to take the place of the old stock houses and are being extended as the latter are removed. The limestone is obtained by the company from its own quarries about one-half mile from the furnaces and is transported in standard hopper cars and dumped directly into the bins. From the bins, the ore and stone for the No. 5 furnace is drawn through gates into McKee scale cars which operate on continuous tracks running in the tunnel and under the bins. These gates are controlled by levers in reach of the workman handling the scale car. Two of these cars, each with a capacity of 85 cubic feet, are used. The scale car track is so extended under the length of the bins that it will serve the adjoining furnaces when they are equipped with skip hoists. The charges of ore and stone are weighed and then automatically dumped from the scale car into the skip buggy by which they are carried to the furnace top. The coke, which is measured and not weighed, feeds directly to the skips from the bin through a steel chute, the gates of which are controlled from the skip-operating house. Each coke bin has two chutes, one for each skip. Part of the coke used is supplied from the company's own by-product works at Steelton, and the balance is purchased in the market.

For operating the transfer car on the trestle, the Simplex system of electrification is used. This method is such that the contacts are not excited until the collector shoe of the car is directly over them. The magnet in the shoe brings the contacts in touch and the circuit is formed. As soon as the shoe leaves the contact box, the circuit is broken.

This system has been frequently used to transfer material in manufacturing operations in iron and steel works but it is thought this is the first time it has been applied to ore-yard service. The system was installed by the Simplex Construction Co., Harrisburg, Pa.

Two of the four tracks on the trestle are electrified, one of these tracks being over the bins and the other under the main span of the ore bridge. The McKee transfer buggy operates over these, either for moving the ore from the yard to supply those furnaces where the bins are not in line with the ore supply or to deliver to the distant furnaces Nos. 1 and 2, both ¼-mile away.

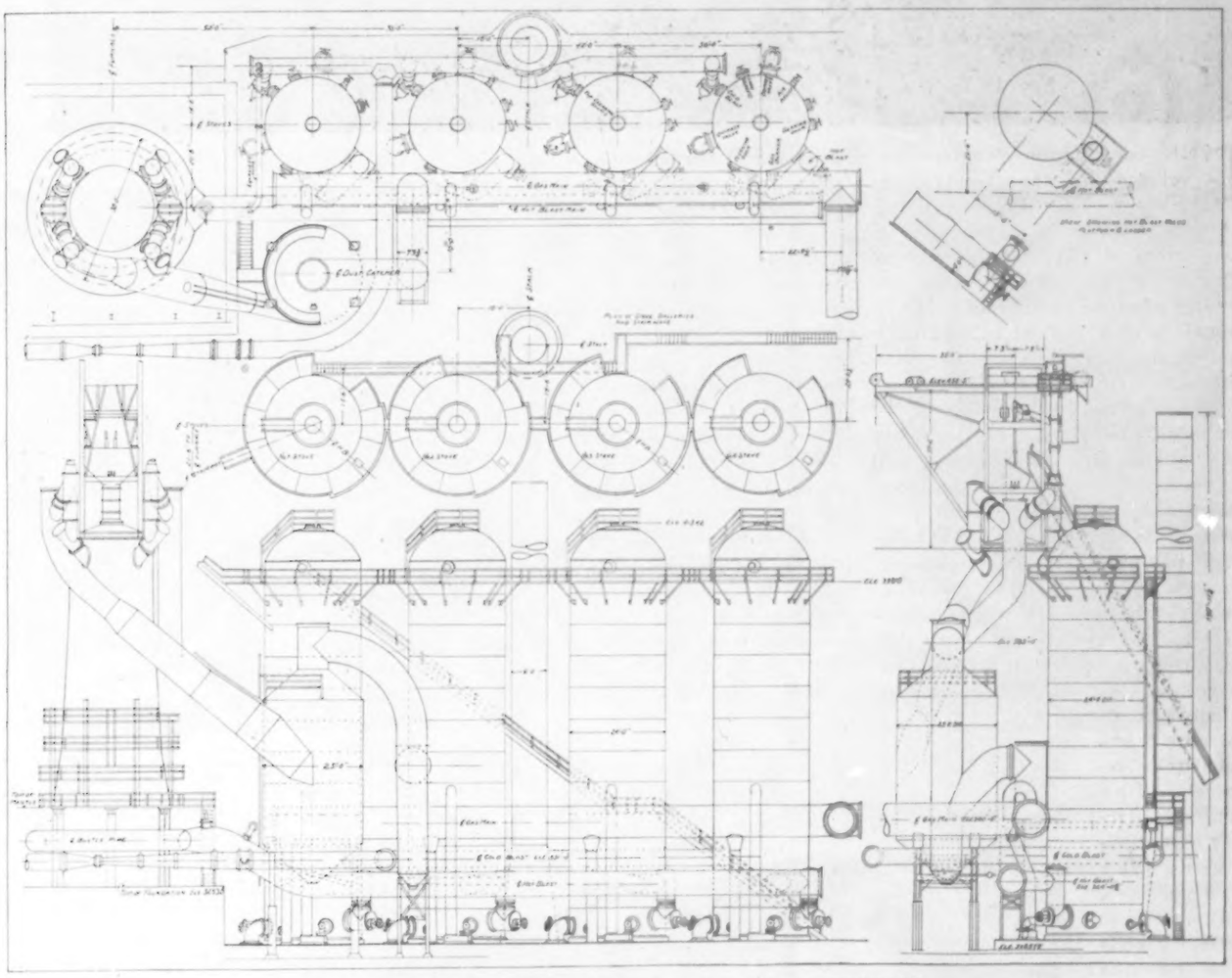
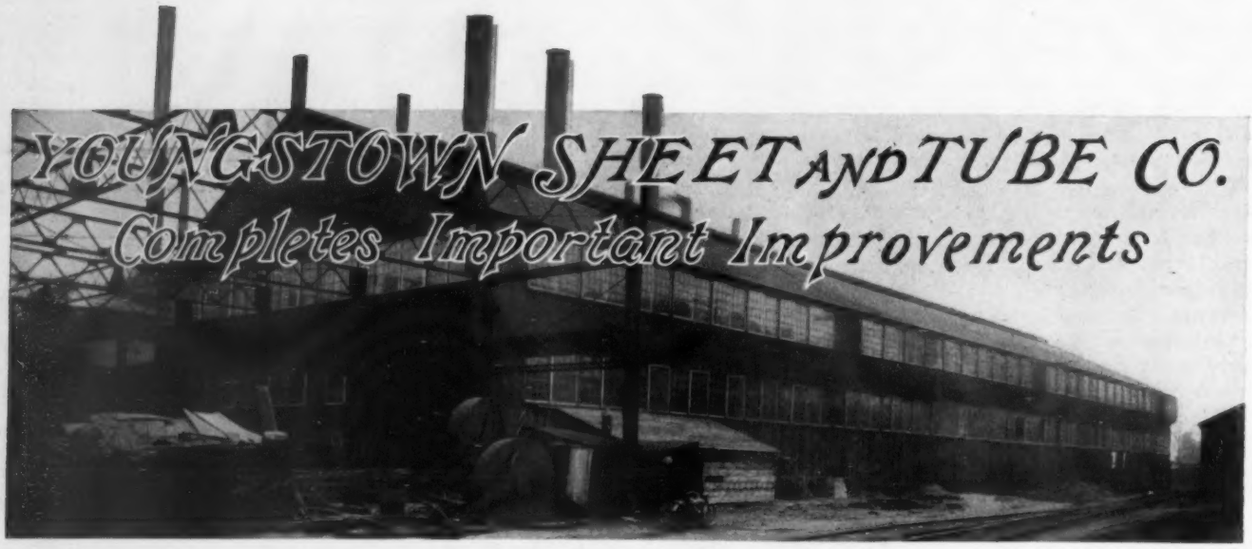


FIG. 5—GENERAL ARRANGEMENT OF NEW BLAST FURNACE

A new power house for the No. 5 furnace has been erected and most of the equipment has been lately installed. The building is 100 x 117 feet and is of steel construction, with brick side walls. The ends are so arranged that the power house may be extended in both directions. The blowing equipment consists of two single-tandem Mesta gas-driven blowing engines of 2,000 horsepower each. The gas cylinders are 46 inches in diameter and the air tubes 84 inches in diameter. The stroke is 60 inches. The engines deliver

(*Concluded on page* 112c.)



YOUNGSTOWN SHEET AND TUBE CO. Completes Important Improvements

THE construction program developed by the Youngstown Sheet & Tube Co. during the year just past, which called for an appropriation of $5,000,000, is said to be one of the most extensive ever inaugurated by an independent steel company in this country. Materially extended after its inception, the final addition to this plan was made on Dec. 14, 1915, at which time the construction of blast furnace E, the fifth of a battery of similar type, was authorized. The four blast furnaces already in operation have been producing an average of 602 tons daily for months past. Notable among other new installations is a bar mill, the completion of which will signalize the entrance of the company into the merchant bar manufacturing business. This mill will consist of two Morgan continuous trains fitted with 9 and 12-inch rolls respectively. The 9-inch mill includes a continuous roughing train of six stands, six stands of finishing rolls and an Edwards sizing mill. It is designed to take billets of from 1¾ x 1¾-inch to 2½ x 2½-inch sections, in 30-inch lengths, and to reduce them down to finished ¼-inch to ⅜-inch round and square sections; also flats up to 2 inches will be rolled. The capacity of this mill, under normal conditions, with fair rolling orders, will be 6,000 tons of average sections per month. The roughing mill will be driven by a 37 x 48-inch Nordberg uniflow engine. Two stands of the finishing rolls will be driven by a 700-horsepower direct current Crocker-Wheeler motor. The four additional stands of finishing rolls will be driven by two 600-horsepower direct current Crocker-Wheeler motors. The sizing mill will be driven by a 100-horsepower direct current motor of the same make.

The 12-inch mill consists of a continuous roughing train of five stands and a finishing mill with two trains, each of the latter including two stands of the staggered duo type. The mill is designed to take steel billets from 1¾ x 1¾ to 3 x 3 inches in section, in 30-inch lengths, and to reduce them to finished round or square ½-inch to 2-inch sections; flats from 1¾ inches to 4½ inches and angles from 1½ inches to 3 inches in width also will be rolled. The capacity of this mill, under normal conditions, should be 10,000 tons of average sections per month. It will be driven by a 44 x 50-inch Nordberg uniflow engine. The 9-inch mill building is 90 x 1,150 feet in dimensions, while the 12-inch mill building occupies an area of 100 x 401 feet.

Each is served by two 15-ton Cleveland cranes. The billet yard and warehouse have each one Cleveland crane of similar capacity. These mills contain 15 alternating current motors and 50 direct current motors for crane and general mill service.

Work is well under way on the construction of three 100-ton furnaces at the eastern end of the present open hearth plant. The equipment will include six Morgan mechanical gas producers, one Morgan low type charging machine and three 616 - horsepower Babcock & Wilcox waste heat boilers. The completion of these furnaces will make a battery of nine. Those now in operation are averaging 125 tons per heat and the new furnaces will be of similar capacity. A new mixer plant,

NEW EMERGENCY HOSPITAL BUILDING

under construction, will contain a 1,300-ton hot metal mixer furnished by the Pennsylvania Engineering Works.

Coke Plant Equipment

The coke plant will include 204 12¼-ton Koppers cross-regenerative coke ovens, designed for 15-hour coking time, and arranged in batteries of 51 ovens each with a by-product plant for the recovery of tar, as well as the Koppers direct process for the manufacture of ammonium-sulphate. A Semet-Solvay benzol plant, which will produce pure benzol, pure toluol and purified solvent naptha, is in course of construction. The coal will be handled by a Wellman-Seaver-Morgan car dumper, which will deliver at either an 8-foot or 62-foot lift. At the former height the coal is delivered into transfer cars for stock; from the latter it is delivered into a 200-ton hopper. The dumper, which is driven by two 400-ton horsepower direct current Westinghouse motors, will handle cars up to 100 tons capacity. From the hopper the coal goes through breakers and hammer mills of the Pennsylvania Crusher Co. type and is conveyed by belt conveyors, built by the Fairbanks-Morse Co., to a mixer bin of four compartments of 500 tons each. From here the coal is delivered to two 1,800-ton storage bins over the ovens. These bins are being built by the McClintic-Marshall Construction Co., Pittsburgh.

The coke-handling and screening station is being built by the Robins Conveying Belt Co. The coke is carried from the coke wharf to the screening station by a belt conveyor about 500 feet long. About 25 feet from the wharf the coke is passed through an oversizing grizzly and crusher, where it may be diverted and loaded into cars. It enters the screening station at a height of about 90 feet from the general yard level and passes from a conveyor over a grizzly screen into the bins, from which it is transferred to the blast furnaces by a 30-ton larry car, the weighing platform being directly under the bin. The coke plant will be reached by a highway bridge connecting with the approach to the main plant and will be connected with the main works by a standard gage railroad bridge across the Mahoning river.

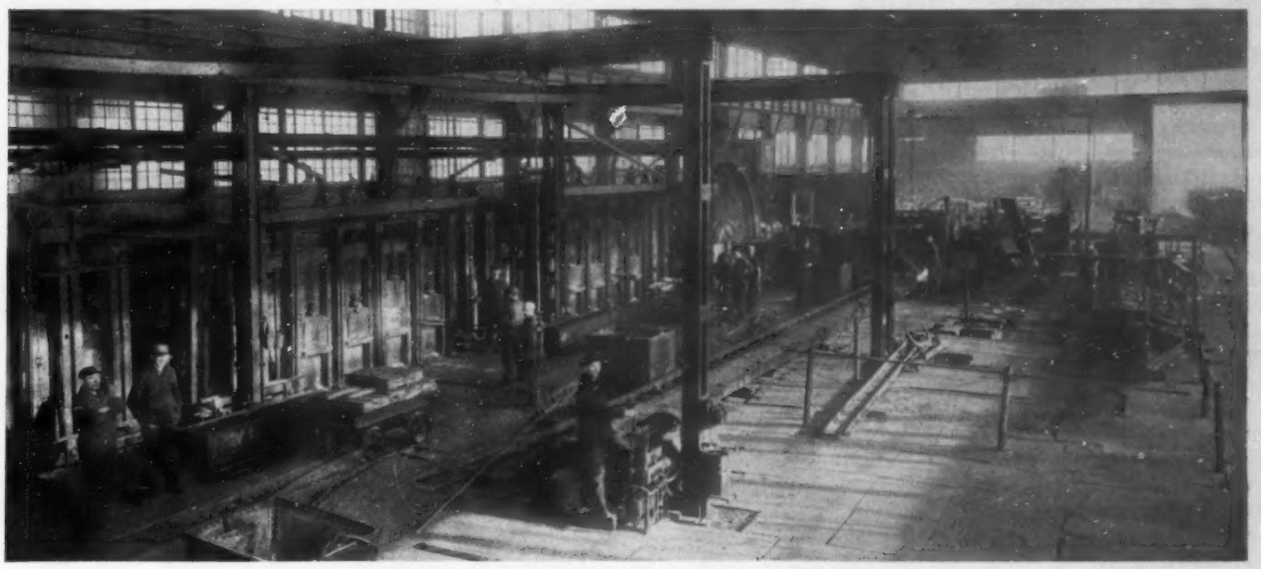
An 18-inch finishing mill has been installed expressly for the purpose of rolling iron and will be used extensively in making socket iron for pipe couplings. This mill is driven by a Tod 24 and 44 x 48-inch tandem compound engine.

Blooming mill No. 1 has been equipped with two 54-inch hot saws provided with accessory tables, conveyors, etc., for handling square-end forging stock. Skelp mill No. 2 has been equipped with tables, conveyors, cooling beds, hot saws, etc., for handling large rounds. Generator and boiler installations to supply the new equipment are now under construction. A new pump house at the merchant mills will contain four De Laval turbine-driven pumps, each with a capacity of 15,000,000 gallons per 24 hours; two will be designed to operate against a head of 135 feet and two against a head of 85 feet.

A new pickling building, for the rigid conduit department, of brick and steel construction, 60 feet x 260 feet, has been erected. It contains a vertical pickling unit of 10 vats. The flexible conduit department has also been largely increased in capacity. Thirty barb wire fence machines have been added to the fence department. The company is building a new general works office at the main plant. It will contain the offices of the vice president, general superintendent, order department, purchasing department, time office, safety department and engineering department; and will be equipped with a restaurant. The building is a four-story fireproof structure of brick and steel, of 158-foot frontage, with a total floor space of 57,800 square feet.

General Laboratory

The general laboratory, situated near the new general office, is a fireproof structure of brick and steel. Its two stories will have a total floor space of 7,140 square feet. The laboratories will be in white enameled brick with asphaltum floors. The emergency hospital, near the main plant, is of fireproof brick and steel construction. It will contain offices for the accident clerk and his assistant, as well as examination rooms, emergency wards, a dispensary, an operating room, an instrument and supply room, etc. The new office building and laboratory are situated on high ground across the river opposite the main northern entrance to the plant.



INTERIOR OF THE NEW 18-INCH BAR MILL BUILDING

When sharpening a broad flat chisel for finish-turning wood for patterns, etc., if the wire edge is left on the edge and the final stropping on a leather block so done that the wire edge is turned upwards, the chisel will make a finer finish than otherwise.

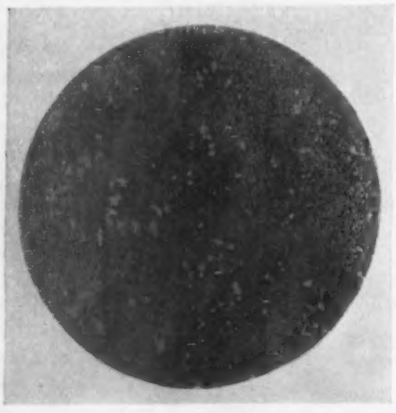
How to Select Your Bearing Metals

THE IMPORTANCE of the bearings in securing the economical operation of machinery has failed to bring about the general adoption of reliable methods of determining the value of different metals for particular service. In many plants no tests are made, while in the majority of cases the tests are inadequate and fail to indicate the actual value of the specimen. The suggestions given herewith should do much to promote uniformity.

By T. H. Soule

NINE out of every 10 purchasing agents and factory officials, when questioned about the bearing metals used in their plants, will answer: "I don't know what kind we use, but I guess it is all right—I don't have charge of that branch of our business." Such a reply, in fact, typifies the attitude of many men who are responsible for machinery, in the operation of which bearings are a vital factor. Considering the fact that bearing metals fill such an important function in the transmission of mechanical motion, and necessarily are used constantly, in immense quantities, it is surprising that their selection so generally is left to methods which are the reverse of scientific.

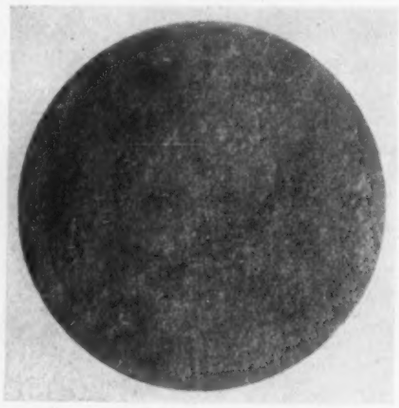
Some concerns have laid out well-defined preliminary tests for determining the better grades of metal before giving them actual service trials; most of these firms also have systematized the handling of the metals in their babbitt rooms, thereby obtaining fairly satisfactory results. In general, however, the handling of bearing metals in different plants throughout the country, varies to a truly remarkable degree. Even a casual investigation indicates that in



ALLOY CONTAINING TIN, LEAD AND ANTIMONY

the majority of cases, the melting men have worked out their own pet ideas. The result is that in far too many instances they fail to secure from the metals a reasonable portion of the service which they are capable of rendering. Such plant methods, naturally, offer a ripe field which may be exploited to advantage by an unscrupulous metal salesman.

To illustrate the careless methods

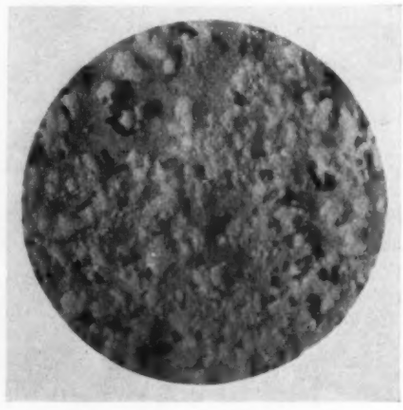


MICROPHOTOGRAPH OF A SPECIAL BEARING METAL

sometimes pursued in selecting bearing metals, it may be stated that the buyer frequently, having made a purchase either on an approval basis, or outright, as the case may be, considers that there is not much left to be done except to get his final report, and decide from it whether or not to adopt the metal. The metal to be tried out is passed along from the purchasing agent to the master mechanic and so on, until it finally arrives in the melting room, where often there is a feeling that all bearing metals look and are alike. In such a case, they are almost sure to be handled alike, regardless of their analyses, the proper temperature for melting, etc. When the trials are over, all the various samples go into the pot together for remelting, being continued in service with the likelihood of resulting in due to scored shafting, break-downs and other causes. Such a course, therefore, is almost sure to meet with failure.

An actual service test, if properly and carefully conducted, indicates whether or not a bearing metal is satisfactory for its intended purpose. Such service tests, however, are extremely expensive since an unsatisfactory metal, when tried out, will probably result in scored shafting, loss of operating time for the machine and other needless expenses. A much more economical and satisfactory way of selecting metals is to establish a testing system which will reveal whether such qualities as resistance to pressure, uniformity of texture and co-efficient of friction, are embodied to the required degree. Generally, such inexpensive, preliminary tests will indicate accurately all that the buyer need know of the metal that is offered him. In any event, they will enable him to reject, without going to the expense of a service test, metals which manifestly are unsuitable.

Progress in the establishment of such preliminary tests is slow, and it is safe to assert that at least 60 per cent of the concerns in the country still base their selections and eliminations exclusively on the results of service tests. Such progress as is noted, however, and the results attendant upon this progress, give ample promise that if the many different methods of testing now in use are succeeded by a simple series of



ALLOY CONTAINING TIN, COPPER AND SPELTER

tests which will indicate the true value of a bearing metal, the financial saving which will accrue to bearing metal users as a whole, will be enormous. Although numerous concerns have

established certain preliminary tests, there is, as previously stated, a surprising lack of uniformity in the methods adopted. Some bearing metal users rely entirely upon analysis; others upon anti-frictional properties of the metal as shown by frictional tests and still others rely upon the resistance of the metal to pressure. Some concerns which have made a more thorough study of the matter, combine some of these tests and in addition, secure microphotographs of the metals, in order to determine the actual grain or texture. Special tests which are relied on by certain large bearing metal users, cover the ability of the metal to withstand hammering; its resistance to shock, and its spending ability, as determined by dropping a weight on a bar of given size; but such tests have only an indirect value in determining the true quality of the metal.

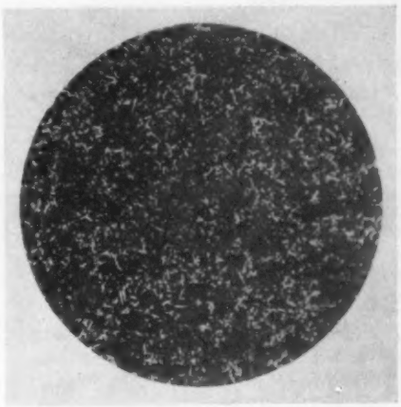
The following combination of tests is recommended for the purpose of selecting the bearing metals which deserve an actual service test:

1.—A test to show the initial resistance of the metal to pressure per square inch, obtained on any standard compression machine or by a Brinnell hardness test, the advantage of the latter being that it is quickly determined and does not require the machining of test pieces. This test not only will serve to eliminate metals which are too soft, but will tend to bring about the adoption of the strongest metals, which are likely to be most economical in service. In conducting this test, a standard of initial hardness should be adopted which must be equaled or exceeded by each metal before it is put in the service trial class.

2.—A friction load test, which should be made wherever possible, as the amount of friction has a direct bearing upon the cost of operation. In fact, the anti-frictional ability of the bearing metal is of almost equal importance with the quality of the lubricants used. Naturally, the bearing metals showing the lowest load, should receive preference over other metals in being selected for the service trial class. If such tests cannot be made conveniently at the plant, samples of the metal should be sent for this purpose to some properly-equipped laboratory.

3.—Microscopic photographs, which show whether or not a metal will score shafting, should be taken. The importance of this item is very often overlooked because the expense of keeping shafting in condition and installing new shafting, where scoring has been done by a bearing metal, is charged to the cost of operation. From the illustration shown herewith, it can be seen that the bearing metal showing the smoothest texture is certain to score shafting less than that which has particles of hard metal showing in the composition. Microphotographs can be obtained easily and at small expense from practically all testing laboratories. The adoption of this test will work great economies in a plant because it will insure the absence of scored shafting, an expense which in many plants amounts to enormous figures; this expense should be charged against the bearing metal which causes the trouble and credited in favor of the metal which does not score the shafting.

4.—An analysis should be made for the sole purpose of guarding against an excessive price for bearing metal. Care should be taken to avoid being influenced by the analysis in the selection of a metal, since analysis and appearance are the most misleading factors in its selection. The composition of a bearing metal and what it looks like, matter little so long as it has the necessary qualities for doing its work.



MICROPHOTOGRAPH OF BABBITT

5.—The melting point should be determined. In most cases, bearing metals melt at sufficiently high temperatures to answer the requirements of service, but where bearings are subjected to severe heat, a high melting point is necessary. In this connection, it is advisable that the temperature at which the molten metal congeals, instead of the temperature at which the metal becomes thoroughly fluid, be accepted as the melting point.

To sum up, resistance to pressure, anti-friction ability and texture should be the deciding factors in the selection of a bearing metal. They are the elements which determine the merits of the composition and which show what can be expected of the metal tested, whether in actual service or not. The tests suggested bring out these features and provide a scientific, common-sense method of selection; they insure the picking out of a bearing metal according to what it will do and not simply by appearance.

American Magnesite in California

(*Continued from Page* 14.)

raw magnesite is a process similar to the manufacture of cement, in that the rock is subjected to about 1,200 degrees of heat in a revolving kiln to drive off the carbon dioxide gas, which makes up about 50 per cent of the weight.

The American Refractories Co. then leased the idle plant of the Buckeye Portland Cement Co., at Harper, O. This plant is fitted for carrying on part of the calcining process, and additional machinery has been installed for the other processes. Operations were begun during December and the plant will be run continuously until shipments can be resumed from Austria.

At the close of the war it is expected calcining of the California magnesite will be discontinued and the Austrian supply will be resumed. Lower cost of transportation is the determining factor. It would be possible to decrease the freight cost if a calcining plant were erected on the Pacific coast so that a finished product might be shipped, necessitating payment on only about half the present weight. But inasmuch as it is felt the end of the war will put the native supply out of question, it is not thought economical to make such an investment, which would be rendered useless when the foreign supply once more becomes available. The reduction in transportation cost by calcining on the coast would leave the freight rate still double that from Austria.

The Radenthein plant of the Austro-American Magnesite Co. has a capacity of about 150,000 tons a year. It was fully described in *The Iron Trade Review*, Jan. 5, 1911, and Oct. 22, 1914. The product is exported through the port of Trieste. Since Italy entered the war the battle line has pushed to within about 50 miles of the works and what the future may hold is in doubt.

Magnesite is quarried from rock deposits in California and as it has not been in large demand in the past, the methods of recovering it have not become highly developed, primitive means being employed in most cases.

English Markets in a Year of War

THE WAR brought many problems to the English iron and steel industry which are interestingly set forth in this review. Not the least of the difficulties overcome arose from unsatisfactory labor conditions due to inflated wages and withdrawals for enlistment. Steel producers have greatly enlarged their capacity but pig iron makers pursued an uneven course. At present there is uneasiness in regard to high prices.

By Joseph Horton

THE year 1915 will be eternally memorable to the British iron and steel trades as having been wholly a war period, differing in this respect from its predecessor. Naturally, the iron and steel trades, as the chief contributors of ammunition and fighting material, have been in the center of the maelstrom, and they may be said to have experienced the full shock of war. It has been a year of extraordinary prices in all finished departments, although, in regard to raw material, the course of events has been unexpected, and, on the whole, disappointing. The largest concerns have made good profits, and have immensely enlarged their productive capacity. But the difficulties associated with manufacture, arising from scarcity of labor and fuel, transit congestion, government restrictions, and, to an unprecedented extent, government control, have been such that manufacturers are all praying they may never have a reptition of such an experience. There is an element of uneasiness prevalent, which did not exist a year ago, because prices have now attained such an altitude that the inevitable slump must involve a large number of traders in ruin. While this induces caution in some directions, the possibilities of moneymaking are tempting the less prudent section of the community into very risky speculations. It has been a year of soaring prices, higher wages than for several decades, involving necessarily an arrogant spirit among many workingmen, all of which has made works management a sore trial to the patience.

PRACTICALLY the whole of steel production at present is for war purposes, municipal, railway and, very largely, structural demands have been hung up to a more convenient season. There have been fewer strikes than in the previous year, but there is evidence, not to be ignored, of wilful slacking and excessive drinking, needlessly cutting down the legitimate profits of industry, while inducing much irritation between employers and employed. The withdrawals from the coal and iron mines and the various branches of the iron trade for enlistments in the ranks have been such that it is wonderful business has been carried on with so great a measure of success. The more thoughtful are wondering what will happen at the close of the war, when the steel trades must have an immensely enlarged capacity for production, for which new markets must be found. It should be added that American consignments of steel, which were rather feared a year ago, have been universally welcomed, equally by manufacturers and consumers. At the close of the year, however, they are approaching the vanishing quantity, owing chiefly to transit difficulties, the disturbance of international exchange, and the enormously increased demand by America for its own products.

Smelters in all parts of Great Britain are telling each other that whatever bad luck has been associated with the war, has all come their way. Prices have been disappointing most of the year. In December last, Cleveland pig iron was round about 54s ($12.96). In January it reached 55s ($13.20), February 55s 6d ($13.32), March 57s ($13.44). Then there was a decided upward movement and the end of March found Cleveland warrants selling at 65s ($15.60). The upward movement continued for some weeks, 68s ($16.32) being reached early in April. Then a bad slump succeeded, and by the middle of May there was a reaction to 63s ($15.12). At the end of June, in spite of enormous advances in finished iron, Cleveland warrants were realizing only 66s ($15.84) and in July a large number of furnaces were blown out. It was very evident at this time that supply had gone completely beyond demand, especially in view of the diminished foreign business. Smelters gradually realized that the make of finished iron was on the down grade, and an effort was made to adjust matters. During the early autumn, the strain became very severe, with prices still round about 64s ($15.36) and tremendously keen competition. The bearish influences had their full effect, and many furnaces must have actually lost money on every ton of iron produced. The real recovery has come only within the last few weeks. At the middle of December 73s ($17.52) has been realized, and stocks were on the down grade, while there were some signs that makers were gradually acquiring a commanding position. The trade has during the year felt severely the complete absence of any sort of organized control, and every ruthless bear movement has found makers entirely at the buyer's mercy. The lack of shipping tonnage has been a serious element in the situation, and the trade has felt severely the loss of very useful European ports. Most unfortunately, makers of pig iron have had to follow every advance in wages conceded to the makers of finished iron under the wages board, a most absurd arrangement, in view of the wide difference between the earnings of the two sections. Unfortunately, for them also, the coal trade is a highly organized industry, and the colliery-owners in addition to controlling selling prices, succeeded in influencing the government to facilitate exports of fuel, which according to well - informed authorities is really wanted in this country. The rise in the price of coke has been most serious. The year began with a scarcity of coke, which threatened at that time to compel a number of furnaces to damp down. The price of furnace coke was then 18s delivered ($4.32), an abnormally high price, but the present figure is about 30s ($7.20). When it is remembered that 1½ tons of coke is

required to produce a ton of iron, it will be seen what a serious item this is. Stocks have been fairly steady in Cleveland, the year commencing with 110,000 tons, and closing with about 120,000.

Steel-Making Irons

Steel-making irons have, of course, had an extraordinary run, and the experience of hematite smelters has differed widely from that of the makers of ordinary iron material. North-east hematite has advanced during the year from 75s ($18.00) to 125s ($30.00), while North-west material has increased from 68s ($16.32) to 122s ($29.28), probably a record rise in the time. The North-west district has had an immense run of prosperity owing to the great consumption of this steel for armor-plates, guns, turrets and similar war material. The great scarcity of ferro-manganese has run up the price, the year commencing with ferro of 80 per cent quality at £10 5s ($49.20) and closing with the same alloy at £20 ($96.00). Stocks of seel-making irons in that district throughout the year have been very low, and in fact, negligible. The total thus held is about 2,000 tons. At the present time, a large number of orders are being refused in the Barrow district through the inability to produce sufficient material. The production of several more furnaces could easily be sold, if the material and the men were available. All these west of England furnaces are booked for several months forward, and they are quite comfortable as to their prospects after the war, because of the large quantities of steel that will certainly be called for. The Barrow district has about 23 furnaces in operation, each producing about 1,000 tons per week.

Foundry irons have been much steadier than ordinary forge brands owing to the large demand for machinery, but as some of the engineering works are less busy than they were, presumably because lathes and war machinery have apparently passed the zenith of demand, this department may taper off a little. With regard to working conditions at the blast furnaces, every furnace manager, at any time during the year, was ready to state that his life was not worth living, with the trials of unremunerative prices, inferior and insufficient labor, deliberate shirking by highly paid men, railway congestion, depriving him of his daily supplies of coke, so that furnace after furnace had to be damped down, and other minor troubles. Now that a real demand has set in, smelters are inclined to make the most of it, and they are hoping to get their opportunity in the early months of the year.

In the finished iron department, the soaring prices present a remarkable contrast to the steady figures on the previous year. The figures for November and December, 1914, published at the end of January showed an average selling price of £7 8s 1d ($35.54). For the two following months the rise was only an additional 8d (16c). Then began a strong upward movement, shown in an average for March and April of £7 17s 6d ($37.80) rising during May and June to £8 10s 9d ($40.98), during July and August to £9 11s 2d ($45.88) culminating in an average for September and October of £10 8s 8d ($50.08) a rise of almost exactly £3 ($14.40) per ton during the whole period. These have carried several wage advances totaling 32½ per cent. The present rate for puddlers is 13s 3d ($3.18) per ton as compared with 10s 3d ($2.46) at the beginning of the year. Owing to numerous enlistments, these higher wages are being paid to a decidedly inferior class of puddlers. The averages already given relate to the Midland district governed by the Midland Iron and Steel Wages Board.

Situation of Makers

Generally speaking, makers of iron of all classes have been able throughout the year to command their own prices. The contrast between their position and that of the pig iron maker has been striking, and has been particularly galling to the latter. The unfortunate smelter has envied his bar-making customer, whom he has represented as coining money, while squeezing the pig-maker to the last fraction. Yet the finished iron producer by no means accepts this as a correct description of his position. A great many mills have been obliged, through lack of men, to run a day turn only, instead of a day and night turn. In a great number of cases, less even than a full single shift has been found impossible, either through deliberate slacking by dilatory or inexperienced workmen, scarcity of fuel, billets, puddle bars or what not, and other circumstances. The close of the year finds iron makers generally with their books congested with orders, which have very little prospect of execution for a long time to come.

Probably no trade has been more completely disorganized than that of the galvanized sheet trade which commenced the year with galvanized sheets at £11 5s ($54.00) and closes with selling prices at £25 ($120.00). For this, the scarcity of spelter is chiefly responsible, prices having more than quadrupled. Many consumers of sheets are painting them, at a total cost of about £16 ($76.80) per ton, but it is agreed that, so far, no adequate substitute for the orthodox spelter coating has yet been discoyered. Spelter is so difficult to

What Will Happen After the War?

The future is exceedingly difficult to forecast. It is agreed, however, that every month of the continuance of the war must enormously inflate the present high prices and; by consequence, increase the risks of the inevitable reaction. The same prolongation may involve also a much further extension of government control, which, though submitted to by compulsion or otherwise, is entirely foreign to British ideas of government in one's own household.

If the war, as seems possible, should terminate during the present year, the principal concern will relate to prices and finance. It is agreed on all hands that, for some time after the war, a huge demand must continue for commercial steel and iron for many purposes. Railroad renewals are being almost neglected, both from scarcity of labor and of steel. Tramway renewals, pipe laying for gas and water purposes, and other municipal enterprises are similarly suspended, and there must be a strident demand for such material when the work can be undertaken. As far as foreign business is concerned, the outlook is far from cheerful in view of the vast withdrawals of liquid capital for war purposes. However, on these matters there is no great anxiety. But the squandering of earnings by workpeople is a matter for general regret and concern, and the reaction of inevitable poverty is seriously regarded, while the swing back of the wages pendulum must bring a great crop of labor disputes.

obtain, that many galvanized sheet makers are not now encouraging business, and many are deliberately ignoring it. The question of spelter becomes a more and more serious problem.

It is well understood in this country that a great deal of business, especially in South America, has gone to the United States during the war, and this country will be rather heavily handicapped in its efforts, when peace once more arrives, to recover its old position in the world's markets. With regard to iron prices generally, the recent extraordinary movements have recalled the ever memorable days which followed the close of the Franco-German war. These have always been considered the palmiest days of the British iron trade when ordinary iron ranged from £13 ($62.40) to £17 ($81.60) per ton. It was generally believed that these days had gone never to be recalled, but there is plenty of optimistic prediction that before the close of the world war, they will be surpassed.

It's Too Bad!

General regret is felt among the heads of the Iron and Steel Institute that the old cosmopolitan feeling, which enabled scientific men in the industry to disregard national barriers, and forswear international jealousies, has been for the time being destroyed by the war. Probably, this boycott will be restricted entirely to Germany when the war is over, although for the present Austria is included in the expulsion decreed at the Iron and Steel Institute meeting. This is entirely a new feeling at Institute gatherings; but its depth and fervor is unmistakable. True scientific enthusiasts regret this as a retrogressive and a narrow-minded step.

Semi-Finished Steel

The full effect of the war has been concentrated on the steel trade. Nothing like the present experience was ever anticipated, and it is a most singular circumstance that a year ago, even after six months of war, there was no exceptional buying, in anticipation of stringency. The first inkling of the position appears to have come in January when there was some rather brisk buying, but at that time joists could be bought for £7 10s ($36.00) and steel sections for £7 15s ($37.20). Even open-hearth billets could be bought at £5 10s ($26.40), a rise of only £1 ($4.80) over the pre-war period. At that time, even the military authorities had not realized the fatal deficiency in ammunition, and the subsequent advances seem to be traceable to that tardy discovery, made probably about three months later. It would be difficult to name even approximately the present selling figure of this same material. It is commonly said not to be obtainable at any price. Bessemer billets can be bought in small quantities at about £13 ($62.40) per ton, more than treble the price obtainable before the war, and, a much stranger fact, more than twice the price at which they were bought after six months of war. In this branch, the trade has been in an astonishing way, caught napping. There must have been innumerable opportunities missed of making money this time last year. At the present time, steel makers with metal to sell can get almost any price they like. For unfinished steel of all kinds, a real famine has developed. Wire rods can scarcely be got at any price, and some of the Birmingham wire mills not directly engaged on war material expect to shut down early in the new year, through sheer inability to obtain rods from any source whatever. Early in December £16 ($76.60) was obtained on the Birmingham market, with £20 ($96.00) for forward delivery. In this branch, the loss of the American supplies has been very severely felt. At first, the Americans seem scarcely to have risen to the occasion, in the character of the material supplied, British wire makers complaining of troublesome variations in the carbon content. But this difficulty seems to have been got over, and British buyers would now be very glad to obtain any quantity of American rods.

It is difficult to name prices for finished steel, as the official figure of £9 15s ($46.80) for angles and £10 ($48.00) for joists is still retained. For months past, steel makers have not troubled to alter these official prices. Apparently, the associations are not holding any kind of meeting, and each maker is a law unto himself, clearly being able, if he really has steel to sell, to get his own price. But small steel bars have been sold as high as £18 ($86.40), and probably £15 ($72.00) would be something like the price for joists and angles. But no branch of the trade has been more upset by the war. The two departments of the fighting services show an insatible appetite for steel, and they are finding keen competitors in Russia and France. The orders placed by these two foreign governments for shell and other steel during the past two months runs into millions of pounds. Italy has also been a large buyer. During the past two months many orders for commercial steel for ordinary purposes have been refused, and very little of such business could now be placed.

Government Control

In one direction the control of the works has been revolutionized, practically every steel works having been taken over, since Lloyd George took charge of the ammunition department. There have been repeated conferences between this energetic man of affairs and steel makers, with a view to more and more steel being turned out. It is a remarkable fact that early in the war, when the question of capturing German trade absorbed a good deal of government attention, definite proposals were made on behalf of the government to the heads of the steel trade, with a view to the capture of German business. It was pointed out by the steelmakers that that could only be done if a reasonable guarantee were given for the conservation of this business, either by means of tariffs or some other form of protection. To this appeal the free trade government gave no encouragement, and steel makers accordingly went their own way. Since the government found it necessary to control the steel works, very large extensions have taken place, and, though no figures are given, it is known that several open-hearth steel furnaces are in course of erection in different parts of the country. It is difficult to see how these can be supplied with orders when the demand falls back to the customary dimensions of peace times. The taking over of the works by the government has been somewhat of a

(*Continued on Page* 108.)

Restrictions on Trade

Among the temporary inconveniences resulting from the war, have been a variety of restrictions upon business, affecting first of all the exporters of pig iron and the importers of Swedish ore, and other materials, while there has been a nice crop of litigation resulting from failure to complete contracts which depended in the first instance upon Belgian and German supplies. The important prosecution for supplying pig iron to the enemy, under which heavy penalties were imposed upon a famous firm of Glasgow merchants, will be fresh in the memory. It is believed that the war must have important permanent results in various directions. There is, apparently, a strong determination in such important colonies as Australia, to put an end to German influence in the control of antipodean metal supplies.

Average Monthly Prices of Iron and Steel Products, 1904-1915

Finished Products in Net Tons. Pig Iron and Billets in Gross Tons

1904

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$14.10	13.75	13.55	14.00	13.80	13.40	13.30	13.35	13.40	13.70	15.60	16.60
Gray Forge Cincinnati	$11.00	11.00	11.25	11.75	11.25	10.75	10.75	11.00	11.00	11.75	14.25	15.00
Plates Chicago	$35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	29.30	29.30	29.30	30.10
Billets (Bess.) Pittsburgh	$23.00	23.00	23.00	23.00	22.00	21.50	21.00	20.00	19.50	19.50	21.00	21.00
Bessemer Pig Pittsburgh	$13.60	13.35	13.85	14.10	13.60	12.60	12.50	12.65	12.75	13.35	15.25	16.60
Beams Pittsburgh	$32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	28.00	28.00	28.00	30.00
Bar Iron Cleveland	$25.00	26.00	27.00	29.00	29.00	28.00	28.00	25.00	25.00	27.00	28.00	32.00
No. 2 Foundry Birmingham	$ 9.75	9.50	9.70	10.00	9.65	9.15	9.15	9.50	9.50	10.65	12.75	13.05

1905

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$17.50	17.50	17.50	17.50	17.25	16.60	16.15	16.35	16.50	17.55	18.90	19.50
Gray Forge Cincinnati	$15.25	15.20	15.00	15.20	14.81	13.35	12.28	13.00	13.00	13.88	15.35	15.75
Plates Chicago	$31.30	32.30	32.30	34.80	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30
Billets (Bess.) Pittsburgh	$21.00	24.90	24.60	25.50	23.50	22.00	22.00	23.50	25.77	25.95	26.30	26.50
Bessemer Pig Pittsburgh	$16.85	16.45	16.35	16.30	16.20	15.65	15.00	15.40	15.90	16.50	17.70	18.10
Beams Pittsburgh	$30.00	31.00	32.00	32.00	32.00	32.00	32.00	32.00	34.00	34.00	34.00	34.00
Bar Iron Cleveland	$33.25	33.00	32.00	32.00	31.50	30.00	29.75	32.00	34.00	34.25	37.20	40.00
No. 2 Foundry Birmingham	$13.50	13 50	13 50	13.25	12.75	11.85	11 00	11.65	11.75	12.50	14.00	14.00

1906

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$19.25	19.25	19.00	18.75	18.50	18.10	18.30	18.90	19.75	21.50	26.50	27.00
Gray Forge Cincinnati	$15.75	15.05	14.85	14.75	14.75	14.65	14.55	15.40	16.50	17.50	21.70	22.00
Plates Chicago	$35.30	35.30	35.30	35.30	35.30	35 30	35.30	35.30	35.30	35.30	35.30	37.30
Billets (Bess.) Pittsburgh	$27.00	27.50	27.65	27.75	27.00	26.25	27.00	28.00	28.50	28.50	29.00	29.75
Bessemer Pig Pittsburgh	$17.32	17.29	17.26	17.25	17.24	17.38	17.57	17.96	18.44	20.06	21.96	22.75
Beams Pittsburgh	$34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
Bar Iron Cleveland	$38.00	35.50	34.00	33.00	32.00	32.00	32.00	33.50	34.00	36.00	39.00	39.00
No. 2 Foundry Birmingham	$14.00	14 00	13.70	13 65	13.75	13.50	13.00	14.15	16.00	17.15	21.25	22.00

1907

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$26.00	26.50	26.75	27.50	27.40	26.50	25.40	24.50	23.60	22.60	20.60	19.00
Gray Forge Cincinnati	$22.60	22.50	22.70	21.50	21.90	21.35	20.55	19.95	18.85	18.45	17.35	15.50
Plates Chicago	$35.30	37 30	37.30	37.30	39.40	39.60	39.60	39.60	36.60	37.60	37.60	37.60
Billets (Bess.) Pittsburgh	$29.75	29.50	29.25	29.75	30.25	31.00	30.00	30.00	29.50	28.50	28.00	28.00
Bessemer Pig Pittsburgh	$22.92	22.78	22.85	22.16	24.10	24.10	23.30	22.90	22.90	22.80	20.60	19.90
Beams Pittsburgh	$34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.05	34.00
Bar Iron Cleveland	$39.00	36.50	36.00	36.00	35.00	34.00	34.00	33.00	33.00	32.50	31.00	31 00
No. 2 Foundry Birmingham	$23.00	23.00	22.75	22.00	21.40	21.25	20.50	19.80	18.12	17.65	16.00	14.91

1908

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$18.24	17.87	17.42	17.21	17.00	17.31	17.00	17.00	16.75	16.50	16.75	17.35
Gray Forge Cincinnati	$14.45	14.06	13.63	13.60	13.50	13.75	13.70	14 00	14.25	14.25	14.25	14.75
Plates Chicago	$37.60	37.60	37.60	37.60	37.60	36 60	35.60	35.60	35.60	35.60	35 60	35.60
Billets (Bess.) Pittsburgh	$28.00	28.00	28.00	28.00	28.00	26.50	25.00	25.00	25.00	25.00	25.00	25 00
Bessemer Pig Pittsburgh	$19.00	17.90	17.86	17.49	16.92	16.90	16.73	16.11	15.90	15.48	16-74	17.40
Beams Pittsburgh	$34.00	34.00	34.00	34.00	34.00	33 00	32.00	32 00	32.00	32.00	32.00	32.00
Bar Iron Cleveland	$28.80	27.00	28.00	28.40	30.00	29 00	29.00	29.00	29.00	29.00	29.00	29.00
No. 2 Foundry Birmingham	$12.80	12 50	12.12	11.90	11.50	12.00	11.60	12.06	12.50	12.50	12 50	13.00

1909

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$17.44	16.75	16.50	16.46	16.21	16.41	16.90	17.37	18.20	18.87	19.00	19.00
Gray Forge Cincinnati	$14.75	14.62	13.50	13.25	13.31	13.50	13.95	14 62	15.25	16.62	16.75	16.75
Plates Chicago	$35.60	34.10	29.60	28.60	28.95	28.60	30.60	31.60	32 80	33.60	35.60	35.60
Billets (Bess.) Pittsburgh	$25.00	23.50	23.00	22.00	22.50	23.00	24.00	25 00	26 00	26.50	27.50	27 50
Bessemer Pig Pittsburgh	$17.34	16.78	16.34	15.80	15 48	16.13	16.37	17.13	18 33	19.68	19.90	19.90
Beams Pittsburgh	$32.00	29.00	26.00	24.00	25.00	26 00	27 00	28 00	30.00	30.00	31.00	32 00
Bar Iron Cleveland	$29.00	28.75	26.20	25.25	25.00	26.20	29.25	30 00	30 00	30 00	32.00	32 00
No. 2 Foundry Birmingham	$13.00	12.70	11.75	11.00	11.00	11 31	12 30	13.00	14.00	14.50	14 50	14.00

1910

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$19.00	18.75	18.25	17.00	16.75	16 50	16 50	16.50	16.50	16.00	16.00	16.00
Gray Forge Cincinnati	$16.50	16.38	15.75	14.88	14.56	14.35	14.12	13.75	13.75	13.75	13.75	13.75
Plates Chicago	$35.60	35.60	34.60	33.60	33.60	32.60	31.60	31.60	31.60	31.60	30.60	30.60
Billets (Bess.) Pittsburgh	$27.87	27.50	27.50	27.00	26.12	25.50	25.00	25.00	24.50	23.38	23.00	23 00
Bessemer Pig Pittsburgh	$19.90	19.42	18.90	18.15	17.09	16.73	16.40	16.21	15.90	15.90	15.90	15.90
Beams Pittsburgh	$31.00	31.00	30.40	30.00	30 00	29.20	28.20	28.00	28.00	28.00	28.00	28.00
Bar Iron Cleveland	$33.00	33.00	33.00	32.50	31.00	30.10	28.00	28.00	28.00	28.00	27.80	27.00
No. 2 Foundry Birmingham	$14.00	13.88	13.00	12.12	11.81	11.60	11.38	11.00	11.00	11.00	11.00	11.00

1911

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$15.00	15.00	15.00	15.00	15.00	15.00	15.00	14.50	14.50	14.50	14.00	14.00
Gray Forge Cincinnati	$13 35	13.25	13.15	13.05	12.90	12.50	12.05	12 05	12.05	12.00	12.00	12.00
Plates Chicago	$31.60	31.60	31.60	30.60	30.60	30.60	30.60	29.60	29.60	26.60	25.00	25.00
Billets (Bess.) Pittsburgh	$23.00	23.00	23.00	23.00	23.00	21.00	21.00	21.00	21.00	20.00	19.70	19.25
Bessemer Pig Pittsburgh	$15.90	15.90	15.90	15 90	15.90	15.90	15.90	15.90	15.90	15.39	15.10	15.15
Beams Pittsburgh	$28.00	28.00	28.00	28.00	28.00	27.00	27.00	27.00	26.40	24.00	22.60	23.25
Bar Iron Cleveland	$27.00	27.00	27.00	26.75	26.20	24.75	24.00	25.00	24.75	24.00	24.00	24.00
No. 2 Foundry Birmingham	$11.00	11 00	11.00	11.00	10 75	10.25	10.00	10.05	10.10	10.00	9.75	10.00

1912

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$14.00	14.00	14.00	14.25	14.50	14.50	14.62	15.30	16.37	17.30	17.87	18.00
Gray Forge Cincinnati	$12.50	12.50	12.50	12.50	12.85	13.00	13.50	13.90	14.75	15.70	16.18	15.75
Plates Chicago	$26.00	25.76	25.90	27.55	28.60	28.60	29.60	30.40	31.35	32.60	33.60	33.60
Billets (Bess.) Pittsburgh	$20.00	20.00	19.88	20.00	21.10	21.88	22.25	22.40	23.75	25.70	26.75	27.00
Bessemer Pig Pittsburgh	$15.15	15.00	15.02	15.15	15.15	15.15	15.15	15.43	15.93	17.75	18.05	18.15
Beams Pittsburgh	$23.00	23.00	23.00	23.40	25.00	25.00	26.00	27.40	28.60	28.60	29.00	29.00
Bar Iron Cleveland	$24.00	23.50	23.50	24.00	24.40	25.25	27.00	27.25	29.00	30.20	31.00	31.00
No. 2 Foundry Birmingham	$10.00	10.00	10.06	10.50	10.95	11.00	11.25	11.65	12.50	13.45	13.75	13.50

1913

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$18.00	18.00	17.62	17.25	16.70	16.12	15.20	15.00	15.00	15.00	15.00	14.50
Gray Forge Cincinnati	$15.75	15.25	15.25	14.25	13.50	12.75	12.75	12.75	13.25	13.25	13.00	13.25
Plates Chicago	$33.60	33.60	33.60	33.60	32.80	32.60	32.60	32.60	31.60	30.80	28.86	27.60
Billets (Bess.) Pittsburgh	$28.20	28.87	29.00	29.00	27.37	26.50	26.50	26.12	25.00	23.00	20.87	20.00
Bessemer Pig Pittsburgh	$18.15	18.15	18.15	17.92	17.90	17.26	16.65	16.52	16.65	16.60	16.09	15.90
Beams Pittsburgh	$29.00	29.00	29.00	29.00	29.00	29.00	29.00	29.00	28.25	27.40	26.00	25.00
Bar Iron Cleveland	$33.00	33.00	31.00	33.00	32.50	32.00	31.20	29.25	28.25	27.40	27.00	26.00
No. 2 Foundry Birmingham	$13.70	13.50	13.00	12.50	11.75	10.80	10.50	11.00	11.00	11.00	10.75	11.00

1914

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$14.25	14.19	14.25	14.25	14.25	14.19	14.00	14.00	13.63	13.30	13 .00	13.00
Gray Forge Cincinnati	$12.75	12 75	12 87	12.75	12.75	12 69	12.30	12.25	12.25	12.25	11 .90	11.40
Plates Chicago	$26.60	27 .35	27 .60	26 .36	25 .80	25 .60	25 .60	27 .35	27 .35	26 .04	25 .00	24.00
Billets (Bess.) Pittsburgh	$20.00	20 .75	21 .00	20 .80	20 .00	19 .75	19 .30	20 .00	21 .00	20 .60	19 .00	18.50
Bessemer Pig Pittsburgh	$15.00	15 .09	15 .15	14 .90	14 .90	14 .90	14 .90	14 .90	14 .90	14 .85	14 .70	14.70
Beams Pittsburgh	$24 00	24 .00	24 .00	23 .60	23 .00	22 .38	22 .20	23 .50	24 .00	23 .50	22 .20	21.00
Bar Iron Cleveland	$26.00	26 .00	24 .75	24 .60	24 .00	24 .00	24 .00	24 .00	24 .00	24 .00	23 .75	23.00
No. 2 Foundry Birmingham	$10.50	10 .50	10 .60	10 .50	10 .50	10 .44	10 .05	10 .00	10 .00	10 .00	9 .88	9 50

1915

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$13 .00	13 .00	13 .00	13 .00	13 .00	13 .00	13 .00	13 .38	13 .80	14 .44	17 .12	18.00
Gray Forge Cincinnati	$11 .40	11 .40	11 .28	11 .25	11 .65	11 .46	11 .50	12 .90	13 .20	13 .65	15 .03	16.20
Plates Chicago	$25 .60	25 .40	26 .80	25 .60	25 .80	26 .20	27 .80	28 .80	29 .80	31 .10	35 .80	39.40
Billets (Bess.) Pittsburgh	$19 .50	19 .50	19 .50	19 .50	19 .50	19 .87	21 .40	23 .00	24 .60	25 .50	27 .75	29.60
Bessemer Pig Pittsburgh	$14 .70	14 .63	14 .55	14 .55	14 .55	14 .58	14 .88	15 .89	16 .80	16 .95	17 .45	19.85
Beams Pittsburgh	$22 .00	22 .00	23 .00	23 .00	24 .00	24 .00	25 .00	26 .00	26 .80	28 .10	32 .50	36.00
Bar Iron Cleveland	$23 .00	23 .00	24 .00	24 .40	24 .00	24 .00	24 .00	24 .50	26 .20	27 .75	30 .00	35.00
No. 2 Foundry Birmingham	$ 9 .50	9 .50	9 .38	9 .35	9 .75	9 .56	9 .60	11 .00	11 .30	11 .75	13 .12	14 20

Charts based on above prices are published as a supplement of today's issue.

Review of English Market

(*Continued from page* 106.)

shock to a powerful and self-sufficient, as well as opulent, industry like that of steel, but matters have been adjested, apparently to the satisfaction of the steel makers.

Tool Steel and Alloys

The experiences of Sheffield during the year would fill an interesting volume. The labor problem has been the most serious, and from all parts of the country able-bodied men, including some hundreds of Belgian refugees have been drafted into the mills and forges. Old workmen, round about 60 years of age, have been brought back to work, very much to their own surprise, while their earnings, greatly exceeding the remuneration of their young days, have surprised them still more. The high wages and the pressure for production at one time tempted a number of the clerks to transfer themselves to the mills and casting shops. But, on the whole, this experiment did not prove a great success, the softer physique of clerical workers being unequal to the great heat and strain. That experiment has generally had to be abandoned, and a number of these clerks, unable to "stand the gaff" in the shop, have since joined the fighting forces in the field.

One of the effects of the war has been the almost complete cessation of American buying of cutlery, and it is notorious that a fair proportion of his majesty's forces are now equipped with razors and other similar metallic necessaries from the United States.

One inevitable result of the war to Sheffield, and to a less extent to other steel centers, must be an increase in the sources of supply of tungsten, vanadium, and other essential alloys for high-class steel. In the spring, it was impossible to get an adequate supply, but some new establishments have since entered the field with, it is understood, fairly satisfactory results. The desire on the part of the authorities to conserve the supply of high-speed steel, and especially to keep it out of the hands of the enemy, necessitated the imposition of somewhat strict regulations controlling its export. For a long time, it was impossible to get high-speed steel away, with any pretense of punctuality. But the cooperation of the Cutlers' Hall was sought and this liberated a great deal of material, the destination of which apparently had no earthly connection with the war.

During the past few months the increased attention given to the production of ferro-tungsten has increased the supply, very greatly to the satisfaction of the Sheffield manufacturer. At the same time, the government found it necessary in September to include this alloy in its supervision of prices. It was decided then to fix the maximum price at 5s 8d ($1.36) per pound for ferro, and 5s 10d ($1.40) for powder. This was very disconcerting to speculators, who had bought on the supposition of a free and untramelled condition of purchase of sale. It is quite likely that the tungsten business will be permanently affected, inasmuch as guarantees to purchase have been given to British concerns which, before the war, had been obliged to abandon the manufacture under the stress of German competition. These firms have now restored their plants and are furnishing material to the satisfaction of users in the matter both of price and quality.

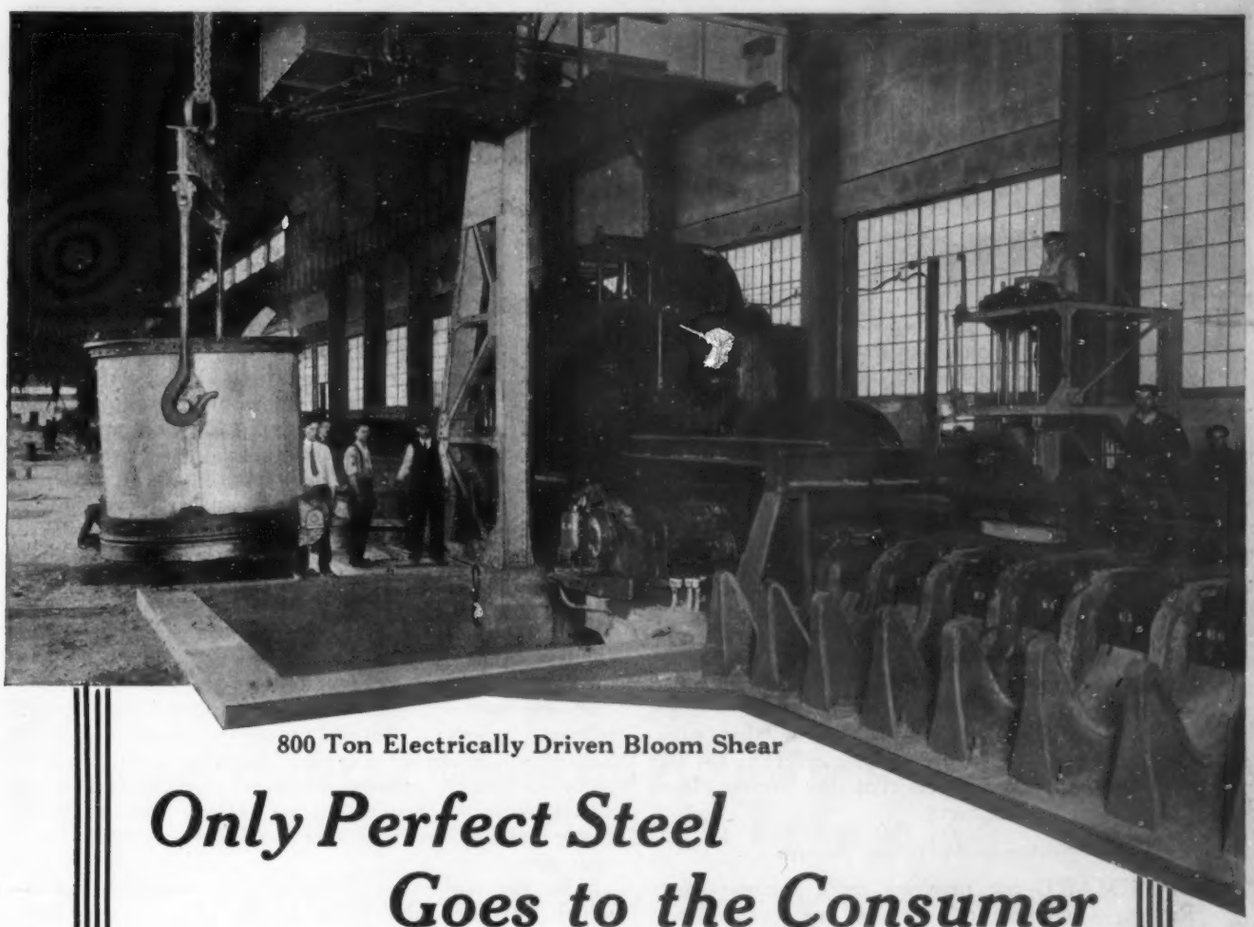
The tinplate industry, like that of galvanized sheets, has had a trying experience and has witnessed a vast increase in values without any corresponding satisfaction to the manufacturer. At the beginning of the year, ordinary boxes of tin plates were selling at about 12s 9d ($3.06), but with an upward tendency. By the middle of February 15s ($3.60) had been reached, and at the end of March, the price had advanced to 16s 6d ($3.96). In June the quotation was 18s 9d ($4.50), and the present selling figure is about 21s ($5.04). The volume of business done, and the profits made have been unsatisfactory throughout the year. This industry, in addition to the serious handicap of scarce and expensive material, is suffering from the loss of its eastern business, Russia and the Balkans having been in times of peace among the best customers of the South Wales mills. The great scarcity of half-finished steel has made it very difficult to keep the mills in operation. The trade, like other exporting industries has suffered seriously from export restrictions and makers have no doubt at all that a great deal of their business has already been captured by America. The immense claims upon the Welsh steel mills for shell steel has made tin bars very difficult to obtain, and it is known that much greater demands for this war steel will be made in the new year. The French supplies of shell steel have mostly been drawn from South Wales, and that district also has been the chief sufferer through the loss of Belgian and German material which formerly came in vast quantities via Newport. A number of the mills which formerly rolled tin bars are now wholly devoted to the making of shell steel.

(*Concluded on page* 112b.)

Speculate on England's Future Tariff Policy

A common element of speculation and surmise is as to the probable effects of the war on tariff questions. The exigencies of an international conflict have thrown into the melting pot so many principles formerly strenuously held that it is difficult even to forecast what may happen in fiscal matters. Undoubtedly, a vigorous effort will be made to carry the war into the industrial arena, when international business is re-opened, though, of course, it is extremely unlikely that such tariff barriers will be imposed against neutral nations and least of all against America.

Among the trades which have suffered most severely, through the stoppage of imports, has been that of wire, for the production of which Birmingham is probably the largest British center. The wire rollers gave nearly all their orders for rods to the Germans before the war, and for this foreign patronage they have had to pay a heavy price. The British steelmakers have not shown any special consideration when appealed to to replace German material, especially as they could sell their finished steel much more advantageously. The prices of wire rods have about trebled and wire prices very nearly so. There is at present a famine in high-class fine steel wire, and while trade is offered from all parts of the world, some of it from former customers of Germany, makers are several months in arrears with their business, and are not in a position to accept more than a small proportion of the orders available. Buyers outside the government have a slender prospect of receiving attention, and although wire makers can get practically what price they please, they are far from happy, especially in view of the provisions restricting their profits. On the whole, they do not expect to derive much permanent advantage from the war.



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AGATHON STEELS

Extraordinary Profits Are Earned

THROUGHOUT 1915 *American machine tool manufacturers worked with might and main to appease Europe's insatiate demands for shell-making equipment, but the New Year dawns with the task far from completed. At the same time the home market has expanded to an unprecedented degree. As a result, production has been tremendously stimulated and prices have soared. Labor troubles are rapidly subsiding.*

THE MACHINE tool industry made a record in 1915 which it is safe to say will not soon be duplicated. Throughout the year, the volume of business was unprecedented; a large number of contracts were booked each surpassing in value any single order taken in previous years. Prices advanced by leaps and bounds and practically all manufacturers greatly enlarged their capacity. When the year opened, the trade found itself in the midst of a burst of activity that had developed in the fall of 1914. This press of business found its source in the insatiate appetite of the roaring guns of Europe, and the demand for equipment for the manufacture of all kinds of war material grew so rapidly that all previous sales records were successively smashed in each of the first four months of the year. Due to continued pressure from buyers, such tools as lathes and automatic screw machines became so scarce that prospective purchasers in many cases offered to pay premiums as high as 50 per cent for second hand tools for immediate shipment.

No Embargo by Great Britain

THE DEMAND for machine tools for export to Russia, England and France was exceedingly large during the first half of the year. In addition there was heavy buying on the part of Italy, Roumania, Greece, and, to a smaller extent, Spain and the Scandinavian countries. During the second half, the demand from practically all these countries, except Russia decreased materially. Toward the end of the year, the latter nation was placing more business than all the other countries combined. Nevertheless good inquiries continue to come in from the other countries.

An interesting feature in connection with the export demand was a royal proclamation issued by the British government, Dec. 2, which prohibited, after Dec. 21, "the importation into the United Kingdom of all machine tools and parts thereof except small tools". A further exception is made in favor of machine tools and parts thereof, "imported under the license of the board of trade and subject to the provisions and conditions of such license". This proclamation at first caused some uneasiness among American machine tool makers, but the latter received assurances that the proclamation was intended only to protect Great Britain against the activities of speculators and unauthorized middlemen. It is believed, according to London advices, that the government commission within whose scope comes the purchase of machine tools, will designate probably five leading English machine tool concerns, with whom responsibility for all machine tool imports will be lodged. Consequently, deliveries on all contracts made with all properly-authorized British representatives, will meet with no interference.

The volume of export business was at flood tide during the first four months of the year, with the result that manufacturers of the machine tools most in demand, found their output sold ahead far into the future. By May, the scarcity of lathes and other tools had become so acute that buyers found it extremely difficult to place further business for reasonable delivery. By the early part of September, the market was sold up approximately as follows: 14 to 16-inch lathes, two to three months ahead; 24-inch lathes and larger, five to six months ahead; turret lathes, five to six months ahead; small hand screw machines, two to three months ahead; automatic screw machines, five to six months ahead; complete units of rifle machinery, six to seven months ahead; practically all kinds of drills, two to four months ahead; shapers, planers, slotters, etc., one to two months ahead; projectile presses, five to six months ahead; dudgeon presses, four to five months ahead; cylindrical grinders, several months ahead, etc. In September, there developed a huge demand for tools suitable for the manufacture of 6-inch and larger shells, with the result that on certain sizes of large-swing lathes, some makers sold their output for a year ahead.

The demand from domestic war munition makers, which involved the same kinds of tools as those wanted for export, also was of the largest proportions during the first half of the year and among such buyers were numbered hundreds of concerns, most of them engaged in the production of explosives, and many in the manufacture of motor vehicles, motor cycles, aeroplanes, etc., for use by the armies in Europe.

Ship Builders Placed Heavy Orders

OUTSIDE of the direct demand for war supplies, and machine tools with which to manufacture them, the war resulted indirectly in the creation of a vast volume of general business participated in by many lines of industry, and this condition led to a constant enlargement of equipment requirements of all kinds. The interning of German merchant vessels, for instance, and the withdrawal of a great many vessels carrying the flags of England and other countries, brought about a tremendous demand for ships. Extensions to shipyards, therefore, necessitated heavy buying of shop equipment of all kinds. Many of the mining industries were stimulated by the war demand, with the result that there was an unusual demand for equipment for mine repair shops.

Railroad buying was of small proportions during the first half of 1915, but due to an enormous increase in traffic, a development directly traceable to the war, these interests came into the market on a large scale during the second half, particularly in October and November, for machine tools and other equipment with which to keep their rolling stock in repair. The activity of the railroads extended to plants manufacturing all kinds of railroad equipment and supplies and such interests also were active buyers. Railroad

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car manufacturing companies, especially, figured in numerous important transactions. The steel companies, in turn, figured as large buyers of machine tools and other equipment.

Prices Go Up

HEAVY advances in prices featured the machine tool market in 1915. These were due, in part, to the increased cost of labor, but, mainly, to the firm position of the manufacturers as a result of the big war demand. The first advances applied to lathes, turret lathes and automatic and hand-screw machines, prices on which were advanced approximately 10 per cent the latter part of March. In June, another advance of 10 per cent was declared effective on these machines and in addition prices on milling machines were advanced from 10 to 15 per cent, on heavy duty high-speed drills approximately 10 per cent, etc. Later, other advances were announced, with the result that prices on machine tools in general were 15 to 50 per cent higher in December than at the beginning of the year.

The magnitude of the transactions arising out of the war demand led to the quoting of exceedingly rigid terms of payment. At the beginning of the year, the terms specified on export orders, generally, were cash against the ocean bill-of-lading, the cash to be paid in New York. Early in the year, the terms were changed to involve a cash deposit equivalent to the value of one-third of the order, the balance to be paid on presentation of the ocean shipping receipts. Later, the terms became even more rigorous and by July 1, the terms figuring in the majority of export transactions were one-third cash deposit with the order, a confirmed bank credit for the balance, the order to be non-cancelable and to have no expiration period and the two-thirds balance to be paid against the factory bill-of-lading. Domestic munition makers were granted somewhat easier terms. The large concerns in most cases were able to place orders for the required machinery without making cash deposits; in most cases, however, they paid cash on presentation of the factory bill-of-lading. As a rule, cash deposits on domestic business were required only of the smaller companies whose capital was not in keeping with the large amounts involved in their machine tool purchases. From such concerns it became customary to request a cash deposit of one-quarter of the value of the machinery ordered, the balance to be paid against the factory bill-of-lading.

The Fly in the Ointment

THE troubles of the machine tool makers were mainly in the form of labor difficulties which affected the question of production seriously, putting many plants as much as a month or two behind in their schedules. The first signs of labor trouble became apparent about April, but it was not until July that strikes began to break out generally in machine tool and munition manufacturing plants. The demands of the machinists in most cases were for an eight-hour day without decrease in pay, and with additional compensation for overtime work. At many of the plants involved, the prolongation and extension of the strikes was averted by granting the demands; this policy of conciliation, in particular, was adopted by leading concerns in Bridgeport, Conn., and some other New England centers. Other concerns adopted the policy of granting additional compensation in the from of temporary "war bonuses", a policy which, by the way, was opposed by the machinists' union on the ground that when the work on war contracts was terminated, the withdrawal of the war bonuses would leave the men on the old basis of pay. Many concerns refused to concede to the demands of the men, and these in all cases, resumed operation after breaking in new men and reemploying seceders from the ranks of the strikers. The strike wave, which affected mainly New England spreading to a number of middle western cities, had lost a good deal of its momentum by October and at the end of the year, little was heard of labor troubles.

Numerous changes in the ownership of machine tool plants was a feature of the year. An important development in this connection was the purchase of two of the largest manufacturers of multiple spindle automatic screw machines, the National-Acme Mfg. Co. of Cleveland and the Windsor Machine Co., Windsor, Vt., by R. B. Phillips and associated interests, the purpose being to make these concerns a unit in a large new company to be called the Phillips Corporation. Another important change was the purchase of the controlling interest in the Reed-Prentice Co., Worcester, by a syndicate headed by Robert F. Herrick, Boston. Another interesting development of this nature was the purchase of the Detrick & Harvey Machine Co., Baltimore, by the Bethlehem Steel Co.

A great many new concerns were organized during the course of the year to engage in the manufacture of lathes and a large number of established concerns temporarily abandoned their regular lines of manufacture, in order to make lathes. Most of this extra production consisted of single-purpose lathes in sizes suitable for making shrapnel. Later in the year, when the demand shifted to machinery suitable for making shells of larger diameter, many of these concerns took up the manufacture of large-swing engine lathes. This tendency in some cases had an unsettling effect on some other lines of machine tools; for instance, a scarcity of radial drills began to develop in September because a great many manufacturers of such tools had gone over to the production of lathes or lathe parts. A number of war munition makers, such as the International Steam Pump Co., the E. W. Bliss Co. and others, not being able to purchase lathes for reasonable delivery, built them in their own plants.

In August, 1914, when the present boom in machine tools began, Cincinnati manufacturers had a sufficient number of machines stored in warehouses to supply a normal trade for more than two years. At the end of the second quarter of 1915, every available engine, lathe, radial drill and milling machine, both new and second hand, had been shipped. At the close of 1915, practically every machine tool maker in Cincinnati had full order books extending well into the first quarter of 1916. Activities during the last quarter of 1915 fell off slightly because of a strike of union machinists which was called Sept. 29. Late in October, the total out on strike numbered about 3,000. Soon, however, the striking machinists began to return to their places, and by Dec. 1, the backbone of the strike had been thoroughly broken.

Introducing Rolling Mill Jim

Fellows I've been in the rolling mill game all my life. I started in as water boy and hustled around and rolled until I've rolled on every damn kind of mill that rolls metal. About all I can talk about is rolls and rolling mills, so until I'm shut off I'm going to have somethin' to tell about rolls. Better keep your eye on this page as I'm liable to get goin' any minute. I've been all through the mill boys and what I say you'll know I have learned by hard knocks—So Long.

(Signed)

Rolling Mill Jim.—

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PENTON'S BOOK NEWS, Cleveland, Ohio
42

English Markets in a Year of War

(*Concluded from page* 108.)

All branches of the iron and steel trades have suffered severely from transit difficulties. This has been one of the obstacles restricting the import of American steel. Even in the early stages of the war, when shipping was irregular, it was far easier to get bars and billets from America than to transfer them from the British ports to their destination. Consignments would lie weeks together without receiving the smallest attention, and, latterly, the scarcity of carriers has aggravated this difficulty. The British buyers on applying for consignments, which have at last reached the receiving station, are invited to cart them to their works. The railway authorities excuse themselves for all laxities, on the ground that they are working mainly for the war, and everything else must be secondary, a position, of course, which the most businesslike British patriot finds it difficult to assail.

Astonishing Stories

In regard to labor difficulties, the most astonishing stories are told. The principal troubles have arisen from the miners. This class has contributed about a quarter of a million to the fighting forces, and perhaps some excuse may be found for underground substitutes not accustomed to the arduous conditions of this class of labor, while older workmen seeking lighter employment have been in many cases tempted back to the pits by the prospect of large earnings. The general result is that colliery owners think themselves fortunate if they can maintain an output equal to two-thirds of that in time of peace. The scarcity of fuel has stopped forges and mills, on occasions innumerable. Apparently, a large proportion of the workpeople, especially in the coal trade, reduce their efforts proportionately as their wages increase. They are concerned only to get an adequate living, and to increase the number of hours they spend away from the pit. To a less degree this seems to apply to the iron and steel trade. As long since as April last, several Staffordshire mills had to be closed, owing to the impossibility of getting sufficient labor to man them. At blast furnaces youths of 16 and 18 normally earning 2s 6d (60c) per day as laborers have had to be taken on by turns and many of them have earned from 30s ($7.20) to 32s ($7.68) for a week's work, while obviously such labor is not very satisfactory. At one blast furnace, the employers gave a section of their men an advance of 15 per cent to keep them together, and encourage them to make better time. The only result was that the men earned exactly the same wages on the higher scale as on the lower so that the increasing wages had actually lowered the output. To the credit of the men's unions it should be stated that both in the iron, steel and coal trades the strongest influences have been brought to bear to induce the men to take a patriotic view of their duties and responsibilities in this time of crisis. In comparative immunity from strikes the iron trade compared rather favorably with other industries; but in May last a group of men employed at Old Mill, numbering about 500, actually struck work, and as they were largely employed on iron for war material, the results were rather serious. Sir George Askwith, the chief industrial commissioner, was brought in and managed to end the difficulty.

Naturally, the shipbuilding industry suffered very considerably, but this has mainly been owing to the large number of yards, formerly devoted to commercial shipping, which are now engaged in the building of warships. Still, the latest returns show the number of ships completed during the year ended June 30 to have been 571, a total of 1,295,623 tons.

Completes First of New Furnaces

(*Concluded from page 99.*)

357 cubic feet of air per revolution and are capable of 80 revolutions per minute. At the present time, about 40,000 cubic feet of air per minute are being used. The power house also is fitted out with an Allis-Chalmers gas-driven blower, of 1,800 horsepower, which has been running about three years. Ordinarily this engine serves the No. 3 furnace. The remainder of the power house equipment consists of two Blaisdell air compressors, which work up to 240 pounds pressure and two small generator sets for ignition. The compressors are used to start the engine and also for operating the top mechanism of the furnace. The power house is served by a 35-ton Toledo crane with 100-foot span.

The power plant draws its gas from any or all of the furnaces Nos. 3, 4 and 5. The blast mains are so connected that any of these three furnaces may be blown from the new power house. The blast power line also connects with furnaces Nos. 1 and 2, but this is reserved chiefly for emergencies.

How Steel Pens Are Manufactured

(*Concluded from page 61.*)

of shafting that serve as journals; bolted to these frames are round sheet-iron "shaking cans", 20 inches in diameter and approximately 9 inches wide. These cans have a capacity of from 17 to 18 pounds of pens each, in addition to the "pot", which serves as the abrasive. For each can there is a card which carries a record of the pens contained in it. The pens are tumbled until writing tests of a number of samples prove they are satisfactory. The pens now are placed in wire baskets and immersed in lacquer, a very thin coating of which renders them rust-proof. To take care of a large demand for colored and plated pens, a considerable portion of the product, before being lacquered, is tinted blue or bronze by a mild heat treatment, which is not of sufficient intensity to warp the nibs of the pens. A great many pens also are plated with silver, copper, gold, etc., for use on cheap fountain pens.

Rigid Tests

The finished pens, before being packed for the market, are subjected to a rigid scrutiny by highly skilled employes. This is an exceptionally exacting task since it is necessary to inspect each pen for 18 to 26 possible defects, depending on the style. This operation, however, like all the others in the pen industry, is full of fascination to the worker, as reflected by the statement of the young woman portrayed in Fig. 10, who said she "would rather inspect pens than eat". This operative turns over each pen with nimble fingers, inspecting on an average of 60,000 pens daily. The performance of the experts in the C. Howard Hunt Pen Co.'s inspection department, indeed, offers a remarkable example of the accurate perceptions developed by workers in a highly special task.

The concluding phase in the handling of the pens consists of packing them into pasteboard boxes, containing one gross each, in which they are placed on the market. Instead of counting pens, they are weighed out in gross lots on a finely-adjusted apothecary's scale employed for this purpose. Into one pan of the scale, 143 pens of a particular style are counted to serve as a standard. Pens of the same style then are poured into the other pan, which is used as a measure, it being known that this pan will descend every time 144 pens, or one gross, have been placed in it.

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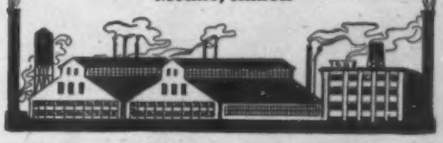

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Of HIGH TENSILE STRENGTH and EXCEEDINGLY TOUGH *Large or small,* we are equipped to make your castings, and guarantee complete satisfaction It is our business to serve you. Quick delivery our specialty *Write us*
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WANTED:—AT A PLANT IN PENNsylvania, two experienced blast furnace foremen or blowers, capable of successfully managing men. Married men preferred. Reply with references. Address Box 698, THE IRON TRADE REVIEW, Cleveland, O.

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WANTED—FOUNDRY SUPPLY SALESman to travel through Michigan for an established manufacturer. One who has had former traveling experience in the same or similar lines. Replies to be considered must state former experience, whether married or single and salary required. Address Box 704, THE IRON TRADE REVIEW, Cleveland.

THE BEST WAY TO GET A GOOD position in drafting or engineering is to file an application direct with some of our clients who are depending on us to get competent and experienced applicants for their vacant positions. Send stamp for blank and list of vacant positions. The Cleveland Engineering Agency Co., Rose building, Cleveland, O.

WANTED:—A COMPETENT SUPERINtendent for furnace to make foundry and basic irons. Married man preferred. Reply giving copies of references and full particulars as to experience. Address Box 699, THE IRON TRADE REVIEW, Cleveland, O.

Positions Wanted

CHEMIST.—FULLY EXPERIENCED IN iron and steel analysis and inspection—would like to have superintendency besides laboratory work. Address Box 680, THE IRON TRADE REVIEW, Cleveland, O.

HIGH CLASS TRAVELING SALESMAN with a large experience and following in Iron and Steel wants position. Address Box 394, THE IRON TRADE REVIEW, Cleveland, O.

ADVERTISING MAN: 26, THOROUGHLY experienced in trade paper advertising. Good copy writer and conservative executive. For personal reasons the writer wishes to leave his present employers who will recommend. Address Box 664, THE IRON TRADE REVIEW, Cleveland, O.

AS GENERAL SUPERINTENDENT OR assistant to chief executive. Thoroughly up-to-date on efficient production and practice, O. H. furnaces, blooming, bar, billet and sheet mills; technical education; 13 years practical experience. Desire change to broader field. Investigate my record. Address Box 625, THE IRON TRADE REVIEW, Cleveland, O.

CHEMIST, DESIRES POSITION IN laboratory of concern in Milwaukee or near vicinity. Experienced on iron, steel, special steels, alloys, iron ores, etc. Address Box 683, THE IRON TRADE REVIEW, Cleveland, O.

WANTED: — POSITION AS TRAFFIC manager.—Sober, steady, middle-age man, married, 17 years' railway experience in official capacity, wide experience in handling traffic matters before Interstate Commerce Commission and various State Commissions, familiar with rate situations in all territories, at present permanently employed, very best of references as to ability and character, desires permanent connection with manufacturing, jobbing or industrial concern. Address Box 710, THE IRON TRADE REVIEW, Cleveland, O.

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Here's the weekly exchange where Employers meet Employes equipped to comply with every exacting requirement—where the experienced man will find a wide market for the sale of his services.

For Employe

Positions Wanted

FOREMAN NOW EMPLOYED, WISHES to make change; have 20 years' experience as pattern maker and foreman, draftsman and designer; last four years in charge of designing, experimental and pattern departments with a large brass firm. Thoroughly up to date on modern shop practice. Address Box 707, THE IRON TRADE REVIEW, Cleveland, Ohio.

BY - PRODUCT COKE OVEN ENgineer—chemical and mechanical, nine years on construction, operation and repairs. Age 32, married and good references. Address Box 708, THE IRON TRADE REVIEW, Cleveland, Ohio.

A MAN WITH CONSIDERABLE EXECutive ability is desiring to change positions. Well acquainted with foundry books and cost methods. Experienced salesman and very good correspondent. Has been associated with automobile and allied industries for past seven years. Is at present secretary of company manufacturing auto parts. Excellent references. Address Box 705, THE IRON TRADE REVIEW, Cleveland, O.

WHEN YOU NEED A HIGH GRADE executive, engineer, draftsman, or any technical man, consult The Engineering Agency, Inc., (Est. 21 years) 1662 Monadnock Block, Chicago.

A-1 FURNACE MAN, 15 YEARS BLOWing and General Foreman, desires to go with good concern. Best of references. Address Box 640, THE IRON TRADE REVIEW, Cleveland, O.

HIGH GRADE FOREMAN WITH FIRST rate experience in foundry practice. Can mix by analysis. At present I have charge of a general jobbing shop. Heavy and light work. Prepared to talk business with the right parties. Address Box 695, THE IRON TRADE REVIEW, Cleveland, O.

PURCHASING AGENT AND OFFICE MANAGER DESIRES CONNECTION WITH PROGRESSIVE CONCERN. 12 YEARS' EXPERIENCE IN OFFICE AND SHOP MANAGEMENT IN STRUCTURAL STEEL WORK AND KINDRED LINES; INCLUDING ACCOUNTING, CONTRACTING AND ESTIMATING. ADDRESS BOX 712, THE IRON TRADE REVIEW, CLEVELAND, O.

THOROUGH MALLEABLE FOUNDRYman experienced also on light and medium weight gray iron, having over 20 years practical experience abroad and states. Past ten years superintending some of the largest plants covering practically all classes of work, lowering costs, reducing percentage of scrap, materially increasing production. Would consider giving services for any period of time to foundries not operating satisfactorily. Further particulars address Box 686, THE IRON TRADE REVIEW, Cleveland, O.

MASTER MECHANIC WANTS POSITION; thoroughly experienced in constructing and operating rolling mills, open-hearth and blast furnaces; by-product coke ovens; water works, hydro-electric and turbo-generating plants; has machine shop practice; best references. Address Box 354, THE IRON TRADE REVIEW, Cleveland, O.

SALES ENGINEER, MEMBER A. S. M. E. wishes line of heavy machinery or mill supplies or steel products for Chicago and adjacent territory. Has made acquaintance with mechanical and purchasing departments of large corporations and railroads. Annual sales for past five years over $200,000. Would arrange on commission basis for established lines or drawing account and commission on new accounts. Address Box 659, THE IRON TRADE REVIEW, Chicago, Ill.